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ANIMAL VACCINATION.

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A MANUAL

OF

ANIMAL VACCINATION

PRECEDED BY

Considerations on Vaccination in General.

BY

DR. E. WARLOMONT,

Member of the Royal Academy of Medicine of Belgium; Founder of the State Vaccine Institute of Belgium; Director of the "Institut Vaccinal de Belgique," at Brussels, etc.

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ARTHUR J. HARRIES, M. D.,

Senior Assistant Physician and Joint Lecturer to St. John's Hospital for Diseases of the Skin; Consulting Physician to the Association for the Supply of Pure Vaccine Lymph; Honorary Secretary to the Willan Society of London; Treasurer to the Sloane Society; Late Honorary Medical Officer to the Holloway and North Islington Dispensary, etc., etc.

WITH AN APPENDIX,

SHOWING THE RESULTS OF RE-VACCINATION AND THE COMPARATIVE UTILITY OF ANIMAL VACCINE.

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INTRODUCTION BY THE PUBLISHERS.

Dr. Warlomont, the author of this monograph, has so long occupied the position of a leader in the movement to establish animal vaccination as the true method for securing protection against small-pox, that we are sure the medical profession and the public will be grateful to us for reproducing his work in a form available for general circulation. We are the more interested in obtaining for Dr. Warlomont, a hearing adequate to the importance of his facts, because in the search for the best virus for propagating in our own establishment, we ascertained that the vaccine bureau of the Belgian Government, of which Dr. Warlomont was the founder, and for a long time the official head, furnished the best vaccine to be procured in Europe.

In this work, Dr. Warlomont presents an admirable *resumé* of the existing knowledge on the subject of vaccine, and he supplements the whole with the results of his own vast observation. No branch of the subject has failed to receive enlightened consideration, and, although he seeks to establish the superiority of the animal over humanized lymph, he exhibits no prejudices against the latter, and only pronounced for the greater utility of the former, after a rigorous analysis of all the facts bearing on the question.

Having satisfied ourselves of the superior excellence of the animal vaccine furnished by the Belgian Bureau, we dispatched thither a special agent—Dr. Sajous, a physician in high standing in Philadelphia—with instructions to procure a supply of the virus, and transport it with all the sanitary precautions necessary. Dr. Sajous executed this mission, the more successfully, since besides his professional qualifications, he is the Belgian Consul of Philadelphia, and had, therefore, official relations with the Belgian Government. The result has justified our efforts to secure lymph of the highest excellence. The virus has proved to be properly active and to produce vesicles which conform in all respects to the typical standard.

Our vaccine propagating establishment is admirably situated. The estate, Rokeby, is a farm of several hundred acres, in Chester county, Pennsylvania, a fertile, rolling country, healthy, and adapted to grazing. There are no great herds in the vicinity, and the cattle of the farmers have been free from epidemic and contagious maladies. The buildings have been constructed with attention to every detail. There are two stables, each of which may contain with suitable regard to the necessary air-space, forty heifers. They are lighted by large windows, kept at a uniform temperature by artificial heat when required by the state of the external temperature, lined with hard wood, and equipped with capacious stalls, mangers, drains, and every appliances which an enlightened experience can suggest. Every detail of administration is carried out by skilled attendants. The heifers are carefully selected and their sanitary condition assured by Dr. Zuill, Professor of Veterinary Medicine and Obstetrics, in the University of Pennsylvania, and the general hygiene and the scientific work of the establishment are under the supervision of Dr. Bartholow, Professor of Materia Medica, General Therapeutics and

Hygiene, in the Jefferson Medical College, of Philadelphia. In fact, nothing is wanting to make our establishment for propagating vaccine lymph, what it professes to be, a model of its kind, without any superior anywhere, and unequalled in this country. We purpose to maintain the excellence of our product by careful attention to every detail, and by the adoption of every improvement suggested by our own experience, or coming from any part of the world.

The readers of this work are invited to see for themselves how nearly we conform to the ideal of its author, and how we maintain the traditions of the Belgian Bureau of Vaccine. Our establishment is always open to the scrutiny of physicians and sanitarians, interested in its objects. We realize, as all do who have had occasion to inform themselves, how important it is to have a vaccine propagating establishment conducted with that scientific knowledge and practical skill, which hitherto have been found only in the official bureaus of the European States. In the absence of governmental control, private resources must accomplish the same end, and attain to the same completeness, both in the machinery and in the scientific character of the work done. We believe that we have accomplished this arduous and important task

GENERAL OBSERVATIONS ON VACCINATION.

INTRODUCTION.

1. **Ever** since vaccine has been known, it has been considered as a liquid, with special properties inherent to it. That is a mistake. Vaccine is a substance found in what is known as the vaccine-vesicle, free in the cells of which this vesicle is composed, or adherent to their circumference, or to the other structures found therein (sheaths of the hairs, etc).

The vaccine-vesicle, in addition, is infiltrated with a serous fluid, which in man escapes directly an opening is made, carrying with it a certain number of the virus corpuscles.

These corpuscles are found in the papules of horse-pox or cow-pox, natural or artificial. Inoculated into the child, they give origin to papules with the same characteristics, and concealing in their turn an element similarly inoculable into the human species, the cow, and the horse: and which in either case is named ***vaccine***.

Vaccine, whether it proceeds in a direct line from the horse or from the cow, possesses equally the same properties—it gives rise to characteristic vesicles, and when it has been inoculated into a subject, human, bovine, physical characters from the small-pox microbe. However, it must have a structure differing in some points which escape our means of investigation, since they give results not entirely similar.

Who can choose from among two poppy-seeds that which will give birth to a red flower, or that from which a white flower will develop?

The kernel of the sweet almond, which gives us a nourishing fruit, is indistinguishable to the eye from the kernel of the bitter almond, which contains the most potent poison; ***no one, however, would dream, from the external resemblance of the two nuts,*** of insisting upon their identity; and no one, for all that, would think of doubting that a difference must exist in their molecular arrangement. These differences indeed are infinitely small, but it is our means of investigation that are deficient. The development of these methods may enlighten us to-morrow, perhaps; perhaps, at some more distant period; perhaps, never. Meanwhile, here is what is known of these bodies, which are so small that with the most powerful enlargements of our best instruments, they only look to us like the *points* of common letterpress.

Klebs gives the following description of them:*—

"The microbes of vaccine, like those of small-pox, are found exclusively in the form of micrococci; and in no phase of their development, do they assume any other aspect than that of the minute spherules.

"Neither in the small-pox pustule, nor in animal vaccine, nor in the viscera of persons who have died of small-pox, do we find tailed forms. We have then to do with pure micrococci, which in all the phases of their development, pass into no other form."

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* Klebs, "Archiv für Experim. Pathologie," x. 2, 3.

The diameter of the vaccine-micrococcus is, according to Klebs' measurement, about 0·6 micromillimètre.

The micrococci of small-pox, and those of the pustules which are found in the calf after inoculation with human small-pox virus, differ somewhat from this diameter—that of the former being greater, that of the latter less. Perhaps the abundancy or deficiency of nutritive material, as well as certain conditions of growth, influence these dimensions. These measurements of Klebs, it seems to us, may err, from the small number of cases from which they have been taken.

Then Klebs notes, as a characteristic more or less common to the microbes of vaccine as to those of small-pox, the disposition—so clear, according to him—to place themselves in groups of four, to such an extent as to deserve the appellation of ***micrococcus quadrigeminus***.

3. How and when do the micrococci appear in the small-pox pustule or the vaccine-vessicle? How does their development take place, and what part do they play in relation to the changes which the anatomical elements undergo?

It is only in the vesicle of the vaccine inoculation that the fate of the microbe has hitherto been well followed. The work of Pincus,* published in 1882, gives in this matter, the most accurate and the most interesting details.

Let us say, then, that the development, the growth of the vaccine-vesicle, does not differ at all, so to speak, from that of the small-pox pustule. It is always the mucous layer of Malpighi which is the seat of the first and principal organic changes. Even when the lancet has penetrated more deeply, carrying even into the meshes of the derma the fluid charged with its microbes, it is always in the epithelial layers that are developed the real phenomena of the vaccine inoculation. According to Pincus, the congestive reaction which succeeds immediately to the slight wound, corresponds exclusively to the mechanical lesion, seeing that it does not vary when inoculation is performed, from the condition following simple puncture. These primary phenomena of reaction subside in turn, with complete cicatrization, within forty-eight hours.

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* "Untersuchungen über die Wirkungsweisse der Vaccination," vol. in 8 vo, pp. 164, mit 4 lithog. Tafeln. Berlin: Hirschwald. 1882,

As for the phenomena indicating the specific action of the virus, though less immediate, at least in their apparent effects, they are not long before they may be discovered. Within twenty-four hours of inoculation, there may be observed in the "rete Malpighii," changes independent of the traumatic reaction, and which may be classed into three zones, of which the innermost, the true centre of inoculation, is the seat of active processes which Pincus believes to be of the nature of necrosis, attributing it to the intensity of the microbiotic action. The nuclei are broken up, the cells become indistinct and develop into diffused masses, structureless and tinged with yellow (primary necrosis). The description by Pincus is similar to that given by Weigert of the small-pox eruption, and disposes of that furnished by French authors.

Whatever may be the nature of this preliminary change *in the epidermic* cells, it is proved that the micrococci multiply in the neighborhood of these foci with extreme rapidity.

The second zone, less actually affected by the virus, is denominated by Pincus "the zone of mild degeneration" (*zone de dégénéréscence trouble*). The third, outside, is that of irritation: the cellular growth here seems to be very active.

As we have said, the slight injury (to the tissues) induces almost immediately a congestive reaction, with increase in the sanguineous and lymphatic circulation. This ordinary period of reaction is very short, and is generally followed on the second day by a marked diminution in the activity of the plasmic coincidents. The consequent rest lasts from twenty-four to forty-eight hours. This depression of the circulation is attributed by the author to the extreme local irritation; it is accompanied by a rapid multiplication of the microbes.

Between the third and fourth days, the protoplasmic increase generally becomes very active, though we do not at present know the reason of this change. It is now that the development of the vesicle begins. Serum makes its way into the zone of inoculation and into that of dull degeneration; the outside zone increases in size, cellular multiplication is still active in it. At length, the epidermis is by degrees distended with leucocytes.

The common inflammatory phenomena of reaction now get mixed with the direct effects of the virus, and the parts played by each can no longer be distinguished. Some hours, generally a day, after the circulation has so actively recommenced, the constitutional feverishness begins. Is this febrile state due to the direct action of the microbes carried into the circulation, and to the effort made by the constitution to expel them? Or, is it the result of a kind of impregnation of the organism by the products of the decomposition and change of the protoplasmic cells attacked by the microbe? We cannot tell. It seems proved, however, that direct injection into the conjunctiva of vaccine-microbes, does not give rise to acute febrile symptoms, and the experiments of M. Chauveau justify this mode of considering the subject; but the attempts made in this direction do not yet suffice to determine the question.

It is in the median portion of the Malpighian network that the micrococcus first develops: it is there also, as we have seen, that are found the first specific alterations. It seems that these small parasites cannot grow well in parts where there exists a very active plasmic current; and, indeed, Pincus notes this curious fact, that on the first day, the multiplication of germs hardly goes on in the zone of inoculation, which is suffering from the effects of lively reaction, and of a more rapid circulation, due to the lesion, but that already one can sometimes observe it further away, arising doubtless from some groups of cells carried by the nutrient lymph, then arrested outside the region immediately attacked.

As soon as the traumatic reaction is complete—that is to say, on the second day—the micrococci undergo rapid increase, this time even in the zone of inoculation. Perhaps they alter all at once, the vitality of the epidermic cells, finding at length, in cells changed or even necrosed, an excellent nidus for their development. The hair-follicles must equally present conditions of existence favorable to the microbes; for, generally, entire colonies are found in them, placed, as we believe, in the preformed interstices of the sheaths and coverings of the hair.

When the reaction of the third or fourth day comes into play, development seems to stop, or at any rate, to be greatly retarded. Without doubt, the newly-formed micrococci are in part carried away by the lymph, and proceed to infect the whole system.

An experiment performed by M. Chauveau seems to prove that this immigration towards the internal parts of the body, is made at even an earlier period. Upon a portion of the skin in the region of the neck, in several horses, he made in a row five or six inoculations with a lancet. Twenty-four or forty-eight hours afterwards, he completely excised the portion of skin which bore the inoculation marks, and united with a suture, the edges of the wound, which healed by "first intention." In this manner, he prevented germ development upon the site of puncture; the local manifestation was necessarily absent. But this virus, previous to the excision of the tissue in which it had been deposited, had had time to enter the circulating current, where it had been bound to act as a general infectant, for at the end of fifteen or twenty days, he was able to establish that a certain number of subjects thus prepared had developed at the "sites of election"—a vaccine exanthem whose characters were absolutely identical with those of natural vaccination.

On the fifth day, a period at which the crop of "lymph" may already have commenced, the micrococci are found in considerable numbers underneath the "horny layer;" often they seem by their growth to have penetrated the groups of cells, separating them like coins. At this period, there exist also in the most superficial layers of the skin, masses disposed in beds parallel to the surface, whilst in the deeper layers, these masses are hardly ever found.

From this time to the eighth day, the micrococci have gained considerably more ground; there are then present, thick masses in the uppermost layer of all the necrosed parts, and groups push themselves forward into the depths of the derma. This takes place especially in the neighborhood of the hair follicles, whose sheaths and perifollicular lymphatic canals serve, so to speak, as guiding channels.

The micrococci of small-pox are generally met with, in the depths of the derma at an earlier period than those of vaccine; often enough one can, at an early period, find entire colonies choking the lymphatic vessels and filling the capillary creeks of the papillæ.

The thing explains itself. In small-pox, a constitutional disease, the migration of the enemy is made from within outwards, and it has to traverse the papillæ in order to reach the selected layer, there to multiply. The contrary is the case with vaccinia, whose microbe travels from without inwards—that is to say, concentrically.

We have seen that, following the outward movement, from the third to the fourth day, a portion of the micrococci is taken up and distributed throughout the organism, while another portion remains on the spot and continues to develop. We have only a few precise observations upon their final destiny.

Many of the micrococci seem to perish on the spot. One finds some whose volume has become much greater through absorption of water, a phenomenon precedent to, or even consequent on, the death of the micrococcus. Other micrococci retain, in the midst of dried cell masses and thickened juices, all their vitality, and keep it for a long time: the virulence of scabs detached from small-pox pustules or vaccine-vesicles— a virulence insisted on elsewhere—sufficiently proves this.

As for the micrococci absorbed and thrown into the general circulation, we know that those of inoculated variola collect in secondary foci when the system presents no obstacle to their action.

In fact, this inoculation brings about the local development of a small-pox pustule, followed on the fourth or fifth day by a general infection, to which the fever—the malaise—bears witness, and which most frequently is itself followed by a disseminated eruption of variable intensity, which appears from the eighth to the ninth day.

The fate of the micrococci taken from these new pustules, or from any varioloid eruption secondary to a general infection, or of those of the vaccine-vesicle, is at present unknown. It seems scarcely possible to doubt that these microbes perish in the body; but where, when and by what mechanism? We can as yet on this subject offer scarcely more than theory, based on analogy with higher fungoid growths injected into the blood, whose fate has lately been inquired into, chiefly by Grawitz.

4. We have got thus far with the examination of this question: how can we explain scientifically the immunity secured by vaccination or inoculation?

Three hypotheses are proffered—(*a*) That of exhaustion, (*b*) that of antidotal power, (*c*) that of cellular alteration.

(*a*) The *first* presupposes that the morbid process induced by the virus consumes, destroys, or annihilates some material, otherwise unknown, whose existence is necessary to the ultimate development of that virus. Originated by Klebs, it seems to have gained over M. Pasteur.

This theory, says M. Grawitz,* is inadmissible; *firstly*, because the body always rapidly replaces constituents that have been wasted; *secondly*, because mould-fungi do not determine decomposition in their surroundings, and leave intact whatever they do not assimilate; *thirdly*, "cultivations" show that the fungi need, in addition to oxygen, only a solution of albumen or peptone, which is not deficient in the blood.

(*b*) The *second* hypothesis (the antidotal theory, Klebs) is founded upon the fact that, in alcoholic fermentation, if the alcohol be in too great a proportion in the solution, it hinders the development of the mycoderm. This has received additional support from the discoveries of Baumann, Brieger, and Salkowski; they have demonstrated that, amongst the products of disintegration ot albuminoid matters, are found bodies which possess antiseptic properties, like carbolic acid, or which are true antiseptics (Wernich).† This theory has had, in so far as it concerns infection from splenic blood, a warm defender in M. Chauveau.

It is not less unlikely, says M. Grawitz again, since one does not see to what bodies the "mould" might give origin; and in any case, in supposing that they may be capable, like the "mucus racemosus," deprived of oxygen, of producing an antidote, the latter could only be in excessively small quantity, considering the infinitely small proportion of the mass of spores to that of the entire organism, and that this antidote must ultimately be carried outside the body by the excretions.

The *third* hypothesis is that of M. Grawitz himself.

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* Virchow's Archiv. Bd. lxxxiv. p. 87.

† *Ibid.* Bd. lxxviii.

What happens, says he, when one injects spores into the blood? A struggle for existence takes place between the latter and the tissue cells. This struggle causes an increase in the vital energy of the latter. The immunity resulting from the primary inoculation would thus be explained by an increase in the power of resistance of our tissues, which, to be effectual, must surpass the vital energy of the parasite. Once induced, this vital resistance may last for months or years, transmitting itself by heredity from one generation of cells to the following.

Let us, in our turn, say to the author that this explanation, which involves the great natural laws of adaptation, etc., makes use of data which are interpreted arbitrarily, and which are infinitely removed from even the semblance of demonstration. None of these three theories, then, can be absolutely accepted. That of "exhaustion," however, does not seem unlikely at first sight. An experimental investigation, reported by Duclaux, plainly shows the delicacy of the germs, their need of nourishment, and their extreme sensitiveness. A "cultivation-fluid" contains a fifty-thousandth part of zinc. One or two generations of "aspergillus" will completely absorb this metal, and will render the existence of a new generation abortive or impossible.

"In such a fluid," says M. Duclaux, "a new "sowing"—I was going to call it a new inoculation—would be fruitless." "Let us add," continues he, "a sixteen-hundred-thousandth of nitrate of silver to the nourishing fluid, and vegetation abruptly ceases. It cannot even begin in a silver vessel, although chemistry may be almost powerless to demonstrate that a portion of the vessel is dissolved in the liquid; but the plant dying, proves it. Imagine the aspergillus a human parasite, able to live, to develop in the body, and invading every part of it. The quantity of nitrate of silver necessary to cause the disappearance of the parasite in a man weighing sixty kilogrammes, would be forty milligrammes. If it multiplied only in the blood, five milligrammes would suffice to arrest the development of a plant so sensitive." It is true that other species might live where the aspergillus would die. Each ferment has its fluid, or its "site of election," and one comes to this conclusion: ***"that all soils are not favorable to all cultivations, and that a favorable nidus is very quickly exhausted."***

The theory of the ether, of its vibrations or its waves, is less justifiable. What scientific language can we use to make this evident? The theory of exhaustion may possibly, under the same title and with this object, help us to simplify the matter.

Whether it be vegetable or animal, the germ of vaccine or of small-pox needs, in order to exist and multiply, an appropriate nidus.

"One cannot," says M. Pasteur, "help thinking that the microbe finds in the body of the animal in which it is about to seek a home, a favorable nidus, and that, in order to complete the cycle of its existence, it does not alter or decompose—which amounts to the same thing—certain materials there present, whether it develops them for its own benefit, or whether it oxidizes them with the oxygen which it borrows from the blood."

Besides, all human beings, to speak only of them, do not appear to be, to an equal extent, a receptacle favorable to the life of the small-pox or vaccine germ. Some are receptive, others refractory.

The germ sticks to the former. In them, it settles down and multiplies, because it there finds its "pabulum vitæ." This once exhausted, it dies of inanition. From that moment, immunity is acquired. If it come upon a subject refractory, either from birth or from previous exhaustion (of the pabulum), it is stranded at the outset.

Let us suppose the enemy *in situ*. It multiplies and nourishes itself until the subject is exhausted. From this time, the latter has no more to fear from its aggressions for an indefinite time, but this time is not unlimited. There may arrive a moment when receptivity becomes re-established, and can only be again destroyed by a new term of occupation.

The germ, introduced anew, exhausts the subject once more, and makes him an unfit soil for new occupants.

For certain subjects, a single colony of inhabitants suffices for their exhaustion; for others, two, three, perhaps ten, may be necessary.

Being unable to determine this beforehand, there is but one mode of procuring positive immunity—that of repeating inoculations at short intervals. In the matter of vaccine, we call that *vaccination*.

It is needless to state that it is re-vaccination which should periodically re-establish immunity.

5. The vaccine vesicle, as we have said before, is infiltrated with a serous fluid, which in man escapes as soon as we give it exit, carrying with it a certain number of the virus corpuscles.

For a long time, it was believed that the vesicle, dried thus by the loss of its contained fluid, ceased to contain virus corpuscles; and in reality, when the first wave has escaped, if one allows new quantities of serum time to arrive, this serum entangles only fewer and fewer microbes, and the virulence of this latter fluid constantly becomes less.

Not that we wish to imply that the vesicle has lost in this manner, all its active constituents. Far from that. We know to-day, and it is not to be doubted, that the framework remains crowded with micrococci, which fact, excision of the vesicles in animals, impossible and unknown amongst children, allows us each day to place beyond the possibility of doubt.

Further on, we shall see what use we have made of this information, in introducing methods of procedure which are of service in preserving animal lymph.

At any rate, if one opens, whether by incision or by simple puncture, a vaccine vesicle at the end of the seventh day, in the human species, so slightly as only to wound the external epidermis, there escapes from it a fluid which one is in the habit of calling "vaccine," similar to lymph-plasma, and holding in suspension divers foreign bodies.

These bodies are:—

1st. The Leucocytes, extremely rare at first; then becoming more and more abundant, until at length, in the purulent stage, they cover the whole field of the microscope. These leucocytes may be in a state of granular or granulo-fatty degeneration, etc.

2d. Dead epithelial cells, various dead fragments often irregular in shape, arising from fission, etc.

2d. Large multi-nuclear cells, developed perhaps by the confluence of several leucocytes, due also probably to the growth and multiplication of the nuclei of the epithelial cells, without corresponding division of the surrounding protoplasm.

4th. The micrococci, described above. They exist nearly alone in the still clear fluid of the young vesicles. At this time, they are isolated. Later on, they are found for the most part joined together in irregular colonies, mixed up with the cellular elements in the fluid.

5th. Free irregular granulations, too irregular to allow of being termed micrococci.

6th. Various adventitious mixtures; red blood corpuscles, cells, and horny epidermic masses, mingled with the liquid; impurities of every sort that are found on the skin, or are attached by accident to the vaccine-vesicle. It is clear that the fluid thus varies considerably according to the period of collecting it, the individual cutaneous organization, the precautions taken in gathering it, etc. It differs considerably amongst the various animals susceptible to vaccination.

6. Thus, as we have just said, the seat of virulence in the bright granulations (microbes, micrococci) is henceforth determined. It is again to M. Chauveau that is due the honour of having experimentally proved this important fact.

Vaccine-lymph from which the solid elements have been separated by the process of diffusion, ceases to be inoculable.

Below are the experiments undertaken by the illustrious Professor of Lyons to establish his demonstration.*

"Upon a single subject (child, horse or cow), one inoculated the skin simultaneously by ordinary methods, at one spot with pure vaccine of good quality, at other spots with various dilutions of vaccine, formed of the same lymp with a gradually increasing proportion of water. One took care to make, in each series of inoculations, the same number of punctures, and to charge the lancet always with a similar quantity of fluid. These experiments have been frequently tried, in such a way as to test the activity of the vaccine-lymph diluted to the greatest possible number of degrees. It is thus that I have come, in these last series, to inoculate vaccine-lymph diluted with 150 times its weight of water.

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*Nature du Vaccine; Determination Expérimentale des Elements.

"As a rule, the first dilutions have shown themselves as active as pure vaccine. Vaccinations done with lymph, diluted with two to fifteen times its weight of water, gave, as a rule, nearly as many successes as punctures. Arrived at the fiftieth dilution, on the contrary, the inoculations miscarried most frequently. I have, however, in a single instance, obtained a vesicle from ten punctures made with vaccine diluted with 150 times its weight of water. As for inoculations performed with vaccine dilutions of a strength from one to fifteen to one in fifty, some aborted, others succeeded, but the number of aborted punctures was always greater with the more extreme dilutions. To these results, it is necessary to add an important observation; in every case in which the inoculation succeeded, the eruption behaved itself in precisely the same way. The vesiculation followed a course, and presented characters identical with the vesiculation produced by inoculation with pure vaccine. Failure or success, then, everything has been clear and complete in these experiments. Nothing mixed, intermediate or attenuated, has been shown in the result of these inoculations.

"Thus, the result of these experiments has proved, upon all points, contrary to the presence of the virus in the plasma in the vaccine-lymph, and in complete conformity with the virulent activity of the solid elements floating in this lymph."

As we have just seen, greatly diluted vaccine-lymph can only very rarely be inoculated with the lancet. If this is really because the virus corpuscles, separated one from the other by dilution, can only exceptionally be carried on the point of the instrument, inoculation *en masse* of the diluted liquid should, on the other hand, certainly succeed, since we should thus place all the virus corpuscles contained in the lymph in contact with the organism. This, indeed, is what never fails to happen. By injecting into the circulating medium vaccine diluted, to it does not much matter, what extent, we infect to a certainty the subject of the experiment. One of the prettiest cases of artificial horse-pox obtained by M. Chauveau was induced by intravenous injection of 8 milligrammes of vaccine-lymph, diluted with 400 times its volume of water. This fluid inoculated with a lancet into several animals before the injection, had, however, not been able to produce in them a single vaccine-vesicle.

These data will be very useful in guiding us in the choice of operative measures in vaccination, and the manner of preserving vaccine, with which we shall have to occupy ourselves later on.

CONCERNING THE MODES OF ORIGIN OF VACCINE-LYMPH.

7. For nearly a century, the question of knowing whether the vaccine we employ to preserve ourselves from small pox, came in the first place from the cow or from the horse, has provided material for the most energetic discussions in the medical world.

When Jenner had determined that a certain number of persons who were occupied in taking care of and milking cows, showed themselves insusceptible to the small-pox virus with which he inoculated them, he recognized that they owed this immunity to something they had previously contracted, doubtless through wounds in their hands—namely, a vesicular disease which they met with on the udders of these animals. Jenner was constrained to admit that the latter had themselves taken the disease from horses, with which they had directly or indirectly come in contact. "There is," says he, "an affection to which the horse is frequently liable on account of its domesticity. Farriers have called it 'the grease.' It is an inflammation and swelling of the heel; from it, flows matter which possesses properties of a special kind, for it seems to be able to originate in the human body, a disease which has so strong a resemblance to small-pox, that I consider it very probable it may be the source of the latter; but this matter must first have undergone a modification. In this milk-bearing country, there are many cows, and the duty of milking them is intrusted without distinction to male or female servants. It may happen that one of the former, after having dressed the heels of a horse afflicted with 'the grease,' has not taken care to wash his hands, and may commence milking the cows, upon the nipples of which, his fingers have deposited some particles of infectious matter which has remained adherent to them. When this is the case, a disease is communicated to the cows and to the maid-servants, which spreads throughout the farm to such an extent, that the entire herd and all the servants feel the consequences."

This passage states explicitly that Jenner admitted as the origin of vaccine, "a disease of the horse's heel, which, transmitted to the cow by germs spilt upon the hands of men who have just dressed diseased horses, is transformed into cow-pox;" and, after having called this disease, "the grease," he has given it later, the name of "sore heels," an ulcerating disorder of the heels, which it will henceforth retain.

Jenner believed, then, that the source of cow-pox is a special morbid matter, developing itself upon the horse, and upon him alone. "I am well persuaded," writes he, "that this disease never develops upon cows, at any rate unless they have been milked by some one who at the same time had charge of a horse afflicted with 'sore heels,' or unless this disease (the cow-pox) had been conveyed to a herd by a cow already infected with it, or by a servant who was already attacked by it."*

8. What then is "the grease?"

It is the disease termed by French veterinary surgeons

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* Ed. Jenner, "An Inquiry into the Causes and Effects of the Variola Vaccine, a disease discovered in some of the Western Counties of England, particularly Gloucestershire, and known by the name of Cow-pox." London, 1798, in 4to, with plates.

Eaux Aux Jambes; by Germans, ***Mauke***; by Italians, *Garpe*. In animals having undivided hoofs, it specially affects the skin at the upper part of the knee and the ham, and that of the lower portion of the limbs, chiefly around the coronet and fetlock, reaching almost to the hoofs; the disease is more frequent on the posterior than on the fore limbs.

"The grease" is described in all works on veterinary medicine. The disease generally has a mild course; sometimes, it disappears from one foot to reappear on another; occasionally, it disappears at the commencement of summer during dry seasons, to reappear in autumn when the atmosphere is moist.

It is not this that can be considered as giving origin to vaccine. The disease is much more like a diffuse phlegmonous inflammation. Isolated and deprived of the complication of vesicles filled with serum, which are sometimes added to it, it is this which in a work dated 1802, and which has long remained unnoticed, Loy ("Account of some Experiments on the Origin of the Cow-pox") called "local grease," to distinguish it from "constitutional grease." *

The "constitutional grease" of Loy is an eruptive vesico-pustular disease, whose characteristic eruption may have its seat upon the skin, or the nasal or buccal mucous membrane; exceptionally only on the conjunctiva. The eruption may appear over the whole surface, but its sites of election are the lower portion of the limbs and the head, where it often becomes confluent. The cutaneous eruption coincides, commonly enough, with that of the buccal mucous membrane, which in some exceptional cases, shows itself only there. The nasal eruption, when it is present, is nearly always accompanied by a similar eruption around the nostrils and on the lips. A slight elevation of temperature, most frequently unperceived, precedes by three or four days, the appearance of the eruptions.

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* Le petit ouvrage de Loy, 29 pages in 8vo, bien qu'ayant été traduit en 1802, par De Cairo, dans la Bibliothèque Britannique t. xxi. p. 377, n'a été connu en France qu'après que M. Bouvier dans un discours tenu à l'Académie de Médecine de Paris, dans la séance du 2 Février 1861, et inspiré des conseils d'Auzias Turenne, l'eut exhumé et révélé. Il donne de la question une solution cherchée ensuite pendant plus de cinquante ans.

The confluence of the eruption at the lower portion of the legs is so frequently accompanied by symptoms such as turgescence, inflammation, ulceration, and secretion, that confusion with the disease known as *eaux aux jambes* has become posssible; hence the idea, so long persisted in, of the vacciniferous property of "the grease."

9. The disease thus defined is that which M. Bouley has introduced into the nosological codes under the name of the *horse-pox*.* The eruption in *natural horse-pox* presents the following characters: at first, when we pass our hand over the body of a horse, we perceive papules of the size of a lentil, and giving the sensation of hard bodies encased beneath the epidermis.

These papules, at the end of two or three days, seem to be about as large as peas, or even larger, through the serum which accumulates in them; they are more projecting, with well-marked borders, and have an umbilication in the centre.

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* Loy: Art. "Horse-pox" from the "Nouveau Dictionnaire pratique de Médecine, de Chirurgie et d'Hygiene Veterinaires," par Bouley et Reynal. Paris. 1881,

At the end of seven or eight days, the vesicle, arrived at complete maturity, is filled with serum : the partition of the apex of the vesicle is not always as clear in horse-pox as in vaccine, and often there are bullous or watery vesicles.

The pustules, which remain, so to speak, vesicles, open easily before the contents have become purulent, especially if they develop in a region in which the hairs are numerous; then the latter are bristling in small bundles, and get up again immediately if one seeks to replace them in their normal direction; on passing the hand along in such a region, it is wetted by the serum which oozes down these hairs. In the vesicles which give way, as in those which dry with thickening of the contents, there forms a scab which adheres to the bases of the hairs, and joins together several of them. These bundles of hairs fall with the scabs at the end of a period more or less protracted (from the fifteenth to the twentieth day), leaving bare a small rounded surface, of a violet-red tint, sensitive to the touch, in which, however, the hairs grow again after some time. Often at a late period, when desquamation commences, one can ascertain the presence of itching. Upon the mucous surfaces, horse-pox shows itself in the form of blisters of the size of a pea—some circular, others oval—whose translucent rose color shows out prominently from the red of the mucous membrane, which, generally inflamed, serves as a support to it. These vesicles are smooth on their surface, without any depression; under the finger they give a sensation of extreme tension, and the animal appears to suffer when one compresses them. When these pustules or blebs follow their regular course, they become successively milky, then purulent; then they dry and give rise to a scab, which soon disappears, leaving in its place a slate coloration.

In the mouth, where the epithelium is easily rubbed off by fibrous foods, the eruption shows itself in the shape of sores, which seem to be made by a punch; the base is finely granular. There is abundant salivary discharge, rendered frothy by the movement of the tongue. This saliva fills the buccal cavity, and escapes in flakes by the commissure of the lips. There is pretty frequently, a mucous discharge by the nose.

Often there is confluence, as in place of vesicles, there may be an ulcerated sore, more or less protected by scales; similar sores are not rare on the alæ of the nose and around the lips.

But the horse may present vaccino-varioloid vesicles, having another origin. These may have been induced in him by the direct insertion, into the cutaneous submucosa, of vaccine-virus derived from the cow, man, or the horse, or perhaps by the absorption of this same virus, injected into the deep cellular tissues, the veins, or the lymphatics. In this case, it is no longer natural but artificial *horse-pox*, that we observe.

10. Whether it be with human vaccine, with cow-pox, or with horse-pox, that one has inoculated, the final manifestations are the same.

The characters and the progress of *horse-pox*, succeeding the insertion of vaccine from the ox, have been described as follows, by M. Chauveau:—"During the first five or six days following inoculation, one does not note anything special. From the fifth to the eighth day, the punctured spots become slightly papular. Until about the tenth day, the vesicles grow and become more glistening, taking the form of a cone much widened, with a breadth of from 10 to 20 millimetres at its base. During this period, these large conical papules are firm, tender to pressure, and present on their surface, no elevation nor any other modification of the epidermis, which presents only a slight bluish tint in animals whose skin is somewhat pigmented. Then arrives a new phase, which may be termed the "period of secretion," and which commences from the ninth to the twelfth day; the epidermis, slightly raised upon nearly the whole extent of the papule, allows numerous droplets of limpid lemon-colored serum to exude; these droplets are soon matted into yellow transparent scabs, forming, over the whole surface of the vesicle, a kind of characteristic crystallization very different from the scab, which succeeds vaccine-vesicles in man, and in the bovine race. The secretion, which persists for several days, ceases from the thirteenth to the seventeenth day of inoculation. If then, one raises the scab, one lays bare a surface, moist, granular, rose-colored, causing no elevation above the surrounding skin. This surface is hollowed out by a pretty deep central cavity—a kind of umbilication in which is embeded, after the manner of a nail, a projection from the deep surface of the scab.

Such are the progress and characters that we generally observe in the vaccine eruption, as induced in the horse.

11. Let us now, however, occupy ourselves with that pox which develops naturally in the cow, and which, by an abuse of language, which ill agrees with modern science, we still everywhere call *spontaneous cow-pox.*

The small-pox of the cow, or cow-pox, is often not accompanied by any constitutional disturbance, by any fever, such as we find in most animals. However, these constitutional symptoms are not always absent, and one has especially noticed loss of appetite, disinclination for food, the continuance of rumination without the return to the mouth of the alimentary bolus, the diminution of the secretion of milk, which becomes more limpid and less thick than of old, and it curdles more easily; the udder is sometimes congested and more tender; one finds then a dryness of the excreta, a lessening of the urinary secretion, more seldom an acceleration of the pulse, and general depression. After three or four days of this eruptive fever, which corresponds to the period of invasion of small-pox in man, one finds as a rule, on the breasts, but especially on the nipples, very exceptionally on the snout, the nostrils, the eyelids, and those parts of the skin where hair is seldom found (Hurtrel d'Arboral, Pilger), rose-colored nodules, rounded elevations almost as large as a lentil, ordinarily already umbilicated. Towards the third or fourth day—about the seventh of the disease— the papules are changed into vesicles or pustules; that is to say, that under the epidermis, or rather in the latter, a serous, viscid, yellow fluid accumulates.

At this period, these vesicles generally present, at their centre, a bluish coloration, and are yellow or orange, sometimes reddish, or even violet, at the circumference. People have occasionally attached extreme importance to this coloration of the vesicles, and have even sought to make of it, an essential feature of the affection, the more so as Jenner had only spoken of the bluish discoloration; if the skin be merely of a fair hue, the shade will be reddish; if it be darker, it will be of a lead-grey. The centre, then, of the vesicle, is most frequently much depressed, umbilicated; the circumference is hard, swollen, and sensitive; and in animals having a clear skin, there is a reddish areola surrounding the vesicle. On the following days, the vesicles increase to acquire, from the eighth to the tenth day—or, according to Ceely, from the ninth to the eleventh—their greatest size; then is the most favourable time to collect the vaccine; only, it is necessary to be careful to make several incisions into each vesicle, in order to lay open, the several compartments which form the swelling. At this time, the vesicles have often the dimensions of a haricot-bean; upon the udder itself, they are circular in form, whilst upon the nipples, they are more elongated; the areola is more complete; in place of simple stains round the vesicle, the circle has a more uniform tint.

The contents of the vesicle soon become purulent. The surface of the pustule appears granular, lightly dotted, and one distinguishes, with the lens, a large number of little vesicles filled with transparent fluid.

Then comes the period of desiccation (the twelfth day), when, spreading from the centre, forms a crust, first yellow, then brown, which extends insensibly towards the circumference. This crust, thick and glittering, crystalline, as has been stated, or rather scaly, is firmly united to the skin, and only separates after the fifteenth day, sometimes, not until the third or fourth week, at any rate unless it be previously raised by an injury; it then leaves after it, a scar more or less deep, which remains for a considerable time. In the bovine race, only occasionally is there suppuration beneath the epidermis with ulceration of the chorion, and then the cicatrix is not indelible.

Rocel and Hering have remarked that the irruption of the vesicles is not always made at the same time, since at the end of several days after the primary eruption, they have often seen new ones, so that there may already be pustules in the stage of desquamation, while others are as yet showing themselves only, in the form of papules; there are, in these cases, vesicles of all ages, ripe and unripe. The eruption may thus show itself by successive steps, and take from eight to ten or even fifteen days before it comes to an end. However, we believe we have noticed, that, once desquamation has commenced, no more new vesicles spring up.

The confluence found in small-pox pustules, is very rare in the cow—that is to say, that seldom are the pustules numerous or near enough to get mixed. There is not, therefore, much erysipelatous inflammation to replace the eruption.

The pustules are easily broken by any friction—for example, by a rough litter or by the hands of the milkmaid. The scabs thus produced, stick less firmly to the skin, and are easily raised, but then they form more quickly, suppuration tends to become more marked, and ulcerating cracks form in their place.

We have not yet observed in cows a concomitant eruption upon the mucous surfaces, such as that which is only too frequent in human small-pox, or the "rot" in sheep. There is, consequently, no nasal catarrh with swelling of the alæ nasi, no dyspnœa, no difficulty in deglutition.

Cow-pox has always a regular course. It lasts barely eight days in what is called the false variety, but from twenty to twenty-eight in the true form. One can distinguish in it a period of incubation, which one can only determine in experimental or inoculated vaccinia; a period of invasion, when we find more or less fever;

a period of eruption, which is characterized by the appearance of vesicles, which are the essential part of the disease; then the period of desquamation, when the pustules are found replaced by scabs. This contagious disease once introduced into a cowhouse, soon spreads, especially among cows which the same individual milks. The disease spreads, little by little, to the other cows, but nearly always in a benign form, rather by a local infection—a species of inoculation—than by a constitutional infection. Once begun in a cowhouse, the cow-pox may remain there for months. We have, then, seen the disease spread to man, notably to people who have the duty of milking cows.

We believe it is determined that a first attack of cow-pox, creates immunity in the animal. However, as the disease passes so often unperceived among our farmers, one cannot state this fact with certainty; too often, small-pox showing itself in the form of what is known as "false pox," is not taken into consideration.

The prognosis of vaccinia is, in nearly all cases, most favourable; the disease appears so benign that the men who watch the cows do not notice it; at any rate, they do not themselves develop any eruption on the hands.

12. The cow-pox may be inoculated into the cow by the insertion of horse-pox, of cow-pox natural or artificial, or of human vaccine. It is upon this property that depends the practice, so developed during recent years, of what is known as *animal vaccination.*

Compared with the effects of vaccination in the horse, those observed in the cow present some differences.

The vesicle in the horse is conical, in place of being shallow and umbilicated, as are those of the horse and man; its umbilication only becomes obvious when the scab has fallen off.

As to the manner in which the secretion of the mature pustule acts, there exists between the pustule of the horse and that of the cow, and of man, a still more marked difference. In the horse, the secretion from the whole surface of the elevation is effective, even to the full extent of its base; whilst in bovine and human vaccine-vesicles, the secretion is only active in the circle circumscribed by the areola. The subsequent scab corresponds to the secreting surface. It thus happens that in the horse, it covers the whole pustule, while in the ox and the child, it occupies only the centre.

With regard to the abundance of secreted fluids, the difference between the horse pustules and those of the ox, is great. Whilst the first furnish a very considerable quantity of the virus-bearing fluid, with which one may fill a great number of tubes, the latter very rapidly becomes spoilt and dried. From a practical point of view, this difference in the fertility of the pustules in the two organisms, should be taken into serious consideration, for if urgency should arise to necessitate vaccination of a great number of subjects at the same time, one would be certain to procure vaccine in greater abundance by inoculating the horse with it, than by trusting it to a member of the bovine species. And, supposing that direct equine vaccination be not possible in any given locality, either from the nervousness of the operators or the subjects, the horse would supply the means of inoculating a great number of heifers and cows. (H. Bouley.)

Differences exist equally, from this point of view, between the vesicle (or pustule) of the cow and that of the infant; for whilst in the latter, the vaccine rises in hyaline droplets to the surface of the vesicle. when one comes to open the vesicle in the cow with the lancet or a needle, it is necessary to express the lymph by means of pretty firm pressure applied to the base of the little swellings, and in the practice of so-called *animal vaccination*, special modes of procedure are rendered needful.

We have seen above (9) that in the horse, the eruption induced by inoculation differs plainly enough from that which develops by constitutional infection. That is not the case with bovine subjects; whatever attention we may give to the one or the other, it is impossible to differentiate the pustule of so-called "spontaneous cow-pox" from that of cow-pox produced by inoculation, by means of a sub-epidermic puncture.

This similarity renders illusory, any research which one might wish still to make into the causes of spontaneous cow-pox, with the object of renewing the stock: the first comer will be able, by means of inoculations well performed, with whatsoever vaccine, to give, on this point, change to the most expert. And the fraud is not wanting to produce that, to which, by a false appreciation of the actual needs of practice, prizes are attached for the discoveries of cases called *spontaneous*.

Happily, this research itself is only a relic of a past age. Wherever animal vaccination is practised, it is absolutely useless. If, indeed, constitutional cow-pox differs from inoculated cow-pox, as has been stated, in its excess of virulence, this excess would not be desirable in vaccinating human beings. Here, on the contrary, it would be necessary to neutralize it by causing the cow-pox to pass, in the first place, through the body of *another of* the bovine race.

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Animal vaccination, as it is performed to-day in nearly every country, does nothing else.

Five times in fourteen years, we have thus renewed our animal stock to satisfy the prejudiced. Never, no never, have we seen the new stock improve upon the old; and that explains how it is that bovine stocks, well cultivated, only deteriorate when they meet with unfavorable soils.

We must know how to manage these difficulties when they present themselves, by bringing forth, reserves prudently managed.

From what precedes, it follows that the economy of the horse lends itself, more readily than that of the ox, to certain manifestations to which the latter may even remain a complete stranger. In the horse, vaccinia simulates more nearly human small-pox; like the latter, it may become constitutional after simple local inoculation, which does not occur in the ox.

13. Facts long known, and those recently discovered, may be brought together in the following propositions:—

1st. Under the influence of a special virulent contagion, small-pox may develop in man under the form of a constitutional malady, characterized by febrile symptoms and a specific general eruption.

2nd. Under the influence of a special virulent contagion, a disease having numerous points of resemblance to human small-pox, febrile symptoms and an eruption, may develop in various animals, but especially in the horse and cow.

3rd. The virus taken from human (small-pox) pustules and inoculated in man, gives rise in him to an identical eruption at the seat of insertion of the virus, and most frequently to a general eruption, discrete and without much gravity, and with general mild symptoms (Variolization, Inoculation).

4th. This same virus inoculated on the horse and the cow, induces in them the production of small elevations, containing a matter which, retransferred to man, produces in him the same phenomena as those of variolization with human virus (Commission Lyonnaise).

5th. The virus borrowed from the disease of the horse, *horse-pox*, or from that of the cow, *cow-pox*, naturally, evolved, and transmitted to man, gives origin in him to a characteristic eruption; that of the horse often induces a well-marked general condition, and sometimes pustules upon parts other than the sites of puncture. That of the cow is less active, and only exceptionally gives rise to a general eruption.

6th. The horse virus passing through the cow is then deprived of its superabundant activity, and, perhaps, if then transmitted to a child, would not induce a constitutional affection.

7th. The *horse-pox* and the cow-pox may be developed by the direct carriage, voluntary or accidental, of the virus, to regions denuded of epidermis or epithelium, whether by independent lesions (*eaux aux jambes*, excoriations of the teats by the milk-maids, etc.), or, by the lancet of the operator. The symptoms produced in this manner remain local.

14. What, then, is this special contagion? We have already, in discussing small-pox, indicated that which conveys the disease to man. Is this contagion the same for man, as for the horse, or for the cow? Or, are there indeed, different contagions for each of these species? *This is the* question of the unicity, or the multiplicity of *the small*-pox, and of the vaccine-germ. The subject of

most interesting discussions for more than sixty years, this question remains to-day almost untouched, demanding from modern science, new elements (of elucidation) which will not be denied to it.

Let us be precise. Here we have small-pox, horse-pox, and cow-pox, developing naturally upon man, upon the horse, and upon the cow, manifesting themselves by local and general symptoms, scarcely differing in the different species, except in degree. Have these diseases, which evidently belong (10) to the class of parasitic diseases, a common germ, or has each its special microbe?

Already, in 1864, M. Depaul had formulated the following proposition:—

"*There is no vaccine virus. Vaccine is nothing but modified small-pox, attenuated in its passage through the system of the horse, or of the cow.*"

These propositions, which not long ago, we energetically controverted, demand henceforth to be treated with more respect.

Everybody to-day knows, that M. Pasteur deprives the virus of chicken-cholera of its excess of energy, by more and more prolonged exposure, in contact with air, of its special microbe developed in a cultivating medium, and thus transmits this disease in a benign form, capable always of rendering animals, which have undergone this form of disease, henceforth invulnerable to its attacks.

He has established also that the microbe, thus deprived of its excess of energy, may give origin to a stock of microbes, in which the virulent energy remains circumscribed within the same limits to which it has been reduced, and that it is thus possible to found "special breeds" (*des races speciales*), in which is preserved only the amount of virulence necessary to enable them to be utilized as vaccine, unable to re-exhibit their primary virulence, except under conditions yet to be determined.

We now know that M. Toussaint (of Toulouse) on the one hand, and M. Pasteur on the other, have arrived by different methods at simular results for the microbe of "charbon." In this case, it is by submitting defibrinated charbon-bearing blood to the action of a temperature of 55°, that M. Toussaint had succeeded in depriving the charbon bacterial fluid, to a certain extent, of its virulence.

M. Pasteur has gone further; and for this purpose, it has sufficed to produce charbon fluid, deprived of germs by keeping them in contact with air at a temperature of 42° to 43°. It is possible to *fix* the attenuation thus obtained by cultivation in a warm fluid, in generations of bacteria yet to be born, and thus *to constitute of it, a generic character.*

Can this lost excess of virulence be restored?

Yes, but under certain conditions.

And these are not visionary ideas; they are facts well and duly acquired for science, and passed for the future into the domain of practice. It will then be permitted to refer to them, and if there is space, to make by analogy, the application of them to other varieties.

15. Whether small-pox floats freely in the air, or whether it secretly breeds in germs, we suppose that it sheds itself indiscriminately over man, the horse, and the cow, and that it may be equally assimilated by all. With this hypothesis—very unlike that which creates a special microbe for horse-pox, which entails another for the cow-pox—all difficulties vanish at once.

The atmospheric virus, attacking man, gives him decided constitutional small-pox, if he have not been sheltered by a previous attack of the disease or by a preventive small-pox or vaccine inoculation, or by an original immunity of an unknown nature. The principal symptoms by which it shows itself are—a febrile state, and the development on various parts of the body of papulo-pustules, whose appearance is well known.

When the virus originating horse-pox—we do not admit that a virus can originate spontaneously in organisms, any more than in the atmosphere—when this virus, we say, seizes upon the organism of the horse under identical conditions, we see the same febrile state suddenly induced, only less vigorously, and pustules produced scarcely different in external aspect, but not differing in internal structure.

Further, if we inoculate the matter which they enclose, it creates immunity from small-pox, or from vaccinia in the animal which takes it, as well as it does in man.

And this is reciprocated in the germ collected from the latter.

And it is the same for the cow; with this difference only, that the reactions here are even less energetic than in the horse.

Well, then, let us admit for a moment that this virus is the only virus capable of communicating small-pox, and everything is at once explained by means of the theory of the attenuation of germs.

Meeting with the organism of the horse, the virus introduces itself and installs itself in a medium different to that with which it is familiar. It there undergoes a depreciation, similar to that which charbon virus, cultivated in a special solution, with proportionate oxygenation and heating, undergoes. For charbon, a temperature of 45° suffices to kill the bacterium in its solution; the growth, on the contrary, is rapid and abundant at 42° to 43°—that is to say, a difference (of temperature) of 2° or 3°. Would it be astonishing that the thermal deviation, which is a degree less in man than the horse, should count for something in this depreciation of the virulent element? And from how many other points of view, is not this difference in the nature of the two media emphasized?

Would there then be anything surprising in the fact that, under the control of such conditions, the small-pox virus should be deprived in the horse of a portion of its virulence? Of that portion, indeed, which rendered it capable of propagation to a distance, and of the minute dissemination capable of exciting that train of constitutional symptoms so marked in man? And, in fact, horse-pox is nothing else, symptomatically, than human-pox deprived of these two elements.

In the cow, it is the same thing, with this difference, that the thermal deviation is two degrees at least. The average temperature in man, is about 37.5°, 38.25° in the horse, and 39° in the bovine race (Zündel). And, curiously enough, as if it were necessary, that facts should give us the reason by anticipation, we find that this thermal variation responds to a corresponding decrease of virulence.

We know, in fact, that the horse-pox is otherwise active as the cow-pox, by this token, that it has been seen to produce a generalized eruption; and there is but one opinion on the danger of inoculating man with it, if it had not previously been made to pass through the body of the ox, which, as everybody admits, deprives it of its excessive virulence, and reduces it to the state of inoffensive vaccine, completing thus the work commenced in its first journey.

The theory, which we have just established, of the single origin of small-pox and vaccinia, furnishes a reply to all objections. Take, one by one, all those which we have reproduced above (26), and you will see that not one holds good before the principal contention, which is so plausible—viz., the attenuation of the germ. All differences, as to mode of propagation, intensity of morbid manifestations, relative frequency of the two diseases, the epidemic or endemic state, adduced by Bousquet, and later by ourselves,* are explained by it without any difficulty.

Bousquet has asked to be informed of what nature, the change, undergone by small-pox, traversing the ox, or the horse, would be. Does this transformation, says he, affect the chemical, or the vital constitution of the virus? Or, does this constitution, remaining the same, limit itself to external manifestations? It is to cry out without cause, when one is shown to be so exigent regarding a matter, so well established, that no one has ever even dreamt of asking its explanation, as to ask ***how*** the virus of so-called spontaneous horse-pox or cow-pox, too virulent to be inoculated in a child, needs only to pass through the body of a cow, to become inoffensive. In the same manner, as the philosopher who demonstrated movement in marching, let us show him the *fact* of the attenuation of viruses by artificial procedures, and let us beg him, not to ask us anything more about it.

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* "La vaccine et la vaccine obligatoire à l'Académie Royale de Médecine de Belgique." Broch. in 8vo, p. 92. Bruxelles; Manceaux. 1881.

But, supposing, says he again, that small-pox should change itself into vaccinia in its land of exile; scarcely has it returned to its own soil, ere it would resume its symptoms, its aspects, and all its belongings. Well, this supposition again succumbs in presence of the experience already acquired, and which, by analogy, we apply so readily to the defense of our thesis :—

"The microbe, deprived of its excess of energy, may give origin to a stock of microbes, the activity of whose virulence remains within the same limits to which it has been reduced, and it is thus possible to establish special races, preserving only the degree of virulence necessary to enable them to be utilized as vaccine" (14).

This virulence, it is true, may reascend to its acme, but only on condition of being cultivated in suitable media, and ***experience has proved that the human medium is not favorable to this reascension, for there is no example of it.***

The facts ascertained by the Lyons commission, remain—facts, whose importance, without ceasing to be considerable, should not nevertheless be overrated. No one indeed, will forget the enormous difference which there must be, between the elaboration of germs through the whole extent of the economy, and that which takes place only in a small corner of space, as happens in the various procedures of inoculation by the elevation of an epidermic shred. And does not nature already point out this difference to us, when she forces us to compare the intensity of the phenomena, resulting from general absorption in natural small-pox, horse-pox, and cow-pox, with the phenomena scarcely sketched in these same affections induced by use of the lancet?

No; before being able to conclude that one is forced to draw results only from inoculations, there are yet some obstacles to overcome: there is, first, the intra-cellular, the intra-venous, the intra-lymphatic injection of human small-pox into the horse and into the cow; then variolar contamination through the atmosphere, of these same animals, by means of virulent matter, inhaled in the form of finely divided powders. If, from these injections or from this contamination, small-pox results, the theory of unicity will still await its demonstration. But, if vaccinia results—oh! then, the great dispute as to the origin of vaccine will be at once terminated; the cow and the horse will be in the future, only the laboratories where Nature herself undertakes to attenuate the germs of which she has need, for the work of prophylaxis conceived by the genius of Jenner.

I have made a great number of experiments in this direction with the illustrious co-operation of M. Hugues, the distinguished military veterinary-surgeon. They have all been performed on horses, and have all had negative results.*

That will not discourage us, we shall begin again. What, if the horses persist in not giving us the desired solution, that will be no reason, why we should believe that they have passed judgment contrary to our ideas. However precise may be the methods of modern experiment, we cannot argue from its silence, when it is pleased to be dumb; and concerning what in this species, experiment until now has been so slightly communicative, it does not follow that its sentence should be final.

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* "Nouvelles recherches sur les origines de la vaccine." Communication faite à l'Académie Royale de Médecine de Paris, le 10 Octobre 1883 (*Gaz. hebdom.* 13 8^{bre}, 1883.)

However it may be, we are compelled for the present, and we are sorry for it, to consider the theory of unicity as simply a hypothesis; a respectable hypothesis however, for there is no other that gives so well, a key to the complex problem of which we have been seeking the solution.

HUMAN VACCINATION.

16. The inoculation of vaccine in the human race, whether it come from a child, or whether it be borrowed from a horse or a cow, is called vaccination. In the first case, it is ***human vaccination;*** in the second, ***animal vaccination.***

We practise the first by borrowing the vaccine matter from one subject, to another belonging to the human species.

Whilst every individual, whatever his age, may with very few exceptions, be capable of receiving vaccine a first time, and of reproducing it, it is generally in children that we seek this reproduction for the purposes of vaccination. There are two reasons for this: the first, that the fine skin of young subjects lends itself more readily to the normal development of the vesicle; the second, that we know, pretty certainly, that we have to do with fresh subjects—that is to say, subjects submitted to a primary impregnation, which is not the case in individuals of greater age. In the latter, an attack of varioloid or a previous vaccination, not having left any apparent traces, may mislead us.

Then, experience has shown that vaccination under these conditions, gives origin only most frequently, to an enfeebled virus, though the vesicles themselves apparently have a normal aspect and development.

When we speak then, further on, of *human vaccine*, it is always to the vaccine of a *child*, that the expression will apply.

17. The mode of vaccinating varies, according as we make use of vaccine fluid, drawn from the vesicle—vaccination from arm to arm—or of preserved vaccine.

I. VACCINATION FROM ARM TO ARM.—CHOICE OF VACCINIFER.

Experience has demonstrated that vaccine, to be of good quality, should come from vigorous and healthy children. One will choose then as vaccinifers, those who have *passed* the age when certain diatheses, the syphilitic for example, may exist without any external manifestations—that is to say, at least, three months. When possible, one will inform oneself of the health of the parents, and will reject every child born of a bad stock.

We shall reject, as vaccinifers, subjects suffering from skin diseases, diarrhœa, or acute maladies of whatever *nature*. It will, therefore, be necessary to examine them thoroughly. If the parents of the vaccinifers object, those of the children to be vaccinated, are charmed.

Choice of Vesicles.—Even when observed in a most healthy child, the vaccine-vesicles may not all be of equal size. This variation makes little difference in the quality of the matter which they contain ; a very small vesicle may give excellent vaccine.

As a rule, this is how true vaccine-vesicles show and develop themselves.

We have stated that, so soon as the lancet of the vaccinator leaves the puncture-spot which it has just made, the latter is surrounded by a small rose-coloured circle, about a line in diameter, which foretells a successful result. This sign, as Bousquet well says,* is common to all punctures of whatever nature; it indicates nothing by preference for vaccine.

"The first, the second, and the third day," says Bousquet again,† "we find nothing, since there is no appearance of life in the punctures, no visible sign of deep and hidden action; so, for inexperienced eyes, the vaccinated subject is as if nothing had been done. This is the period of incubation common to all contagious diseases, but especially to the eruptive fevers.

"From the third to the fourth day—a little sooner in summer, a little later in winter—we find on each puncture, a red point, more apparent to the touch than to the eye; indeed, the finger very easily distinguishes a slight swelling; it is only beginning, but it cannot stop there.

"The fifth day, counting from that of inoculation, or the second of the eruption, the elevation is more prominent, but there is as yet, no special character sufficiently marked, to enable us to recognize it for what it really is; so that if we had not been informed of its history, we should not suspect its nature.

"On the sixth day, it is impossible to be deceived. In place of developing at its apex, as it had commenced, the elevation becomes wider, flatter, hollows slightly at the centre, and assumes a pale tint with a blue tinge, which looks like the reflection of silver or mother-of-pearl. At the same time, the base is surrounded by a little red circle, as yet much circumscribed, but which each day extends more widely.

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* Bousquet, "Nouveau traité de la vaccine et des éruptions varioleuses." Paris: J. B. Baillière, 1848.

† *Ibid.* p. 171.

"The seventh and eighth day are the same symptoms, a little more marked. The vesicle, then, in its full vigour, is seen with all its distinguishing characters; one or two lines broad, of an azure white, surrounded by an areola more or less extensive, depressed at its centre, and surrounded by hardened edges, glistening, more elevated than the surrounding surface.

"On the ninth and tenth days, this show of symptoms acquires still more intensity; but the most remarkable change occurs in the areola, whose colour, more vivid, more scarlet, disappears with more difficulty on pressure being made with the finger, and extends for nine or ten lines in all directions. The subjacent parts are congested, and this congestion is proportionate to the intensity and the extent of the areola.

"After the eleventh day, the elevation begins to dry up; the silvery tint changes to brown, the areola diminishes, becomes pale and yellow; at length, about the twelfth or thirteenth day, the vesicle becomes dry, and is transformed into a hard, dark crust, which falls from the twentieth to the twenty-fifth day, leaving in its place an indelible cicatrix, so characteristic that, with a little experience, it is nearly always easy to recognize its origin.

"The vaccine-cicatrix is round, deep, figured, crossed by lines, and studded with a crowd of little black specks, which doubtless correspond to the cells with which the inside of the vesicle is furnished. It would be superfluous to add, that the more recent the cicatrix, the more is it mixed up with the tissues, but it is never completely effaced."

It is not always necessary that all true vaccine-vesicles should correspond to every detail of this description, even in the most healthy children.

We have seen the typical vesicle present itself on the seventh or eighth day, in the form of a white turban, surrounded by a red areola, causing an elevation bounded by hard and glistening margins. It is not always thus. Sometimes, the areola is completely absent; sometimes, even, it is the elevation that is lacking; the tumour seems to be developed internally more than externally; the turban is replaced by a whitish mother-of-pearl zone, always surrounded then by an inflammatory areola, but making no elevation appreciable to the passage over it of the finger; the latter, on pressure, perceives only a sensation of induration, more or less deep.

At other times, again, the vesicle, in the child, presents the same characters as those which are most frequently found in the adult, whose skin is less delicate and less pliable. It is less flat, less umbilicated; it has neither the same regularity of form nor the same brilliance; the elevation is less clean, the edge less decided; the areola less vivid, less intense. In a word, it offers, in all its external characters, something undecided, more easy to feel than to describe, and which assimilates it, in some respects, to what is called "false vaccine."

In spite of these varieties of form, the vaccine enclosed in these vesicles, if the child be of a good stock and has received good lymph, may be used to inoculate others, with the same success as happens with that which comes from typical vesicles. If, however, the latter deserve the preference, it is because in them the lymph is more abundant, situated more superficially, and exuding more readily. One will choose those, then, in vaccination from arm to arm, as well as for the collection of lymph in tubes, to which they lend themselves more readily than the others, which are more difficult to get at and more liable to an admixture of blood.

In order to obtain the vaccine from the vesicles of a child, it is of importance that we should seize its arm firmly and stretch the skin well. The vesicles then stand out in marked relief. This done, by means either of a lancet or a grooved needle held obliquely to the surface of the little swelling, we open the latter at different points, by punctures or superficial incisions.

We will take care that the child may not be able, by its movements, to anticipate the instrument; and on that account, we will take for the hand that holds the latter, a *point d'appui* upon the arm (of the child) itself; and we will go to work with a light touch. If any blood appear, that vesicle must be discarded.

The punctures should be numerous, for, by only making one, there will come only a very little fluid, the cells which hold it not having any intercommunication. We must attack the vesicle by its surface and its edges; we then see the vaccine liquid rise in clear droplets; we receive it on the point of the lancet, or in the hollow of the grooved needle, and we proceed to the operation itself.

18. *Insertion of the Vaccine.*—This has for sole object, the placing of the vaccine in contact with the mucous layer of the skin (rete Malpighii). For that, a simple puncture by means of a needle or a pin, suffices.

The puncture, says Bousquet, is of Asiatic origin, as is also inoculation with small-pox. Abandoned to common women, this operation was performed by them with three needles tied together. To this procedure, as simple as it was easy, they added, according to *Eastern* custom, the most superstitious practices. Two strangers to our profession (Sutton *père et fils*) did away with this charlatanry, and acquired a reputation for themselves, which rapidly conducted them to fortune.

They say that the English profession became jealous of them, but it had the good sense to adopt the method, which, since then, has superseded all others without dispute.

The *puncture*, indeed, is a simple and certain process if one operates from arm to arm—that is to say, with *actual* vaccine which has not been exposed to any influence capable of disintegrating its elements. Certain to be charged with some of the corpuscles in which resides the virulence, the point of the lancet or the grooved needle, passed under the epidermis, deposits them there to a certainty.

Some precautions, however, are necessary. The operator must *insist* that the arm of the infant about to be vaccinated shall be free from any clothing, in order that he may be able to hold it by its lower part with his whole hand; with four fingers on one side and the thumb on the other, he tightly stretches the skin; then, applying the point of the needle charged with the vaccine fluid, obliquely and on a slope relatively to the handle—in order to guard against the liquid running off the point, as ink does from a pen when we hold the nib too perpendicularly—he makes a superficial *puncture*.

If the needle, or the lancet bear vaccine only on one side, it is this side that should face the skin; the puncture made, before withdrawing the needle, we make a slight movement of raising the point in such a way as to produce a small epidermic funnel, and we shall thus be certain to ensure the arrival of the vaccine at its address. There is another method—that of applying the thumb over the point of the instrument, as if to wipe it against the lips of the wound, so some vaccinators recommend: an unfortunate precaution, for the finger carries away with it nearly the whole of the liquid in place of keeping it at its destination.

We have been considering vaccination performed on the arm; it is custom that pronounced for this site of election. One chooses the upper and outer part of the arm in preference to any other, for the simple reason that it is the most convenient spot. Some mothers ask us to vaccinate their children on the thigh, in order to avoid visible cicatrices on the arm. There is no good reason why we should refuse; it is necessary only to choose the superior-external part, less exposed to the contact of excrement than other parts of the limb.

It is customary to make three punctures on each arm; for boys, one may arrange them triangularly; for girls, it is better to place them in a horizontal line, at a distance of a thumb's breadth from each other. If one wishes to please the mothers and spare subsequent reproaches, one will ask the mothers to point out at what heighth, they would like them placed. The horizontal arrangement allows of concealment of the cicatrices that will form, by the smallest possible sleeve.

One will avoid, as much as possible, drawing blood, not so much for fear that the vaccine will be carried away by it, as because relatives are frightened at it, and particularly because, in going deeply enough into the skin to make it bleed, we go beyond the layer in which the vaccine will develop (rete Malpighi). When the baby is held, seated on the arm of its nurse, and the latter, like the surgeon, is placed in a good light, the operation ought to be performed without any appearance of blood, and without the child uttering a cry. What matters, shall we say? And we shall say wrongly. The more we take away anything formidable in the operation—pain and cries—the more shall we bring together believers and practitioners. It is necessary that, when the time for vaccination is come, no mother should be deterred by fear that we might make her little one suffer.

The vaccination complete, we cover the arms, at the level of the punctures, with a pad of wadding, in order to maintain an equable temperature, and to preserve them from blows, from rubbings, and especially from scratchings which are termed ticklings, of which they very soon seem to be the seat.

There is something more in fact, in the act of vaccination, than the subcutaneous puncture; there is the introduction under the epidermis, of a germinative principle which the instrument of the vaccinator places there. This principle, whether it be virus, microbe or ferment, immediately begins to proliferate, invades the adjoining interstitial paths, is sometimes even carried to some distance (supplementary vesicles), and induces in the tissues, a nutritive change which borders on the phenomena previously described.

Between the moment of insertion of the vaccine, and the fall of the crust with which the vesicle finishes, there is a period of from three to four weeks.

There are germs immediately at the point of insertion, those which have been left there, and which soon multiply.

In about four or five days, sometimes sooner, the swarm at the inoculated spot already makes a mound under the epidermis, and this heap grows until about the tenth day, when the swelling suppurates, then shrivels and dries.

The virulence of the contents of this little swelling, is greater according as the swelling itself, is younger. It is then by mistake that we have accused it, in its earlier stages, of producing only false vaccine; the contrary is the truth. About the seventh day, in the child, the vaccine-lymph is sufficiently abundant to supply what we need, without the active principles being below the desired standard, as they come forward normally to the point of the vaccinator's lancet. After the seventh day, serum is in excess, and a larger quantity of lymph is necessary to furnish a good vaccination.

It is then the seventh day, or rather the commencement of the eighth, that one chooses by preference, for collecting the product of the vesicles—not, once more, because it is then most active, but because it is the most convenient period after inoculation at which it is possible to collect the lymph in sufficient quantity.

19. *Vaccination by means of preserved Vaccine.*—Vaccine is more active when employed at a period more nearly approaching that of its generation. Vaccination from arm to arm corresponds most nearly to this condition, and it would be desirable that the absence of a link might never interrupt the circle.

But this is not always possible, and the need of reserves to refresh the stocks, lost by want of direct human vaccinifers, has always been felt; hence, the search for the most appropriate methods of preserving, for a certain period, in vaccine removed from its vesicles, the greatest possible amount of activity.

The problem to be solved is more complex than appears at first sight. To preserve the microbe alive for the longest possible time, is one essential; to isolate elements whose introduction into the organism constitutes a danger, is another of no less importance.

When one makes a slit or a puncture in the skin of a child, and when one places in it some animal matter, one risks each time the question of life or death. To make the danger great, it suffices that the lymph be putrid at the moment of its introduction.

Doubtless, all children in whom we shall have inoculated putrid vaccine will not die, but all will have been threatened. And it is, probably, because we have thought too little of this eventuality, that we have seen, and still so often see, inflammatory accidents complicating vaccination, especially when it is done with preserved lymph: these are phlegmonous pustules, erysipelas, abscesses. To the observer who has carefully watched vaccinations performed from arm to arm, and in other ways, it is beyond doubt that, in the latter, there are added supernumerary phenomena, due to the introduction into the artificial wounds of substances, playing nearly always the rôle of foreign bodies, often that of specific or septic principles.

In whatever way we take it, it is difficult to avoid this action of preserved lymph, but it is easy to discard, absolutely, the danger of septic action. It is to that that we must chiefly look. We shall see how seldom it is guarded against.

The best time for collecting human vaccine is that at which it is most active. This truth needs no demonstration; unfortunately, this period is too near that of inoculation to admit of a sufficiently free collection; we must wait until the vesicle has attained a certain development, until the vaccine flows spontaneously from punctures made on the surface of the vesicle. One cannot, in fact, in the child as we do in animal vesicles, express, by pinching, the vaccine shut up in the depths of the vesicle; one must content oneself with what exudes, naturally. But the vaccine fluid scarcely exudes, in any quantity, until the end of the seventh day. Sooner than that, there is not sufficient. Later on, there is too much—that is to say, that the active corpuscles are then drowned in too great a proportion of serum. Later still, it presents the other inconvenience of being mixed with *pus*.

We proceed to consider the ordinary methods of preserving human vaccine.

20. *Glass Plates.*—"These plates," says Bousquet, "are square; their sides are 6, 8 or 10 lines long; two of these are taken and placed alternately upon a freely opened vesicle, in such a way that the moistened spots exactly correspond. We repeat this little manœuvre twice or three times, and when we think the quantity of vaccine retained by them is sufficient, we apply them one against the other, after having given the vaccine, however, time to become a little thick, so that it should not spread too much; it is a matter of two or three minutes. In France, it is customary to seal them, somtimes with white wax, sometimes with sealing-wax. In England, we do not take this trouble; we are content to bring the slips carefully together and to wrap them in tin-foil.

"I willingly adopt this process; it is more simple and equally as certain as others more complicated.

"If the plates be destined for a long journey—across the sea, for example—we place them in a little bottle with a large neck: this bottle is itself enclosed in a larger one, and between the two is placed a freezing mixture of nitre and chloride of sodium.

"When we wish to make use of the vaccine, spread and dried upon these plates, we must separate them. That is easily done with the point of a penknife; that managed, we begin by reducing the vaccine once more to the liquid state. Some advise that it should be exposed to the vapour of warm water; others, and Jenner among them, prefer cold water. We are of the same opinion as Jenner. Not that we should use freezing water: no extremes. The most convenient temperature at all times is that of an inhabited room.

"Although water does not sensibly change the properties of vaccine, it is better nevertheless to use it with discretion. For myself, I am content to plunge the point of the lancet into a glass of water; no more is necessary to moisten, to soften the thickened vaccine, and to render it fit to be inoculated. The remainder of the operation is, as if performed from 'arm to arm.'"

Thus does Bousquet express himself. He could not foretell, it appeared, that many vaccinators, chiefly mid-wives (*sages femmes*), whose interference in this matter one hardly tolerates, found it easier to use their warm breath—often perfumed with spirits or tobacco, or perhaps impure for other reasons—to replace the drop of pure water, of which we have spoken, and thus put the finishing touch to the inconveniences of a practice which should no longer exist.

The employment of glass plates, such as we have described, entails evidently a number of imperfections; one would have wished to point them all out.

In applying the plates with more or less delicacy, to the opened vesicles, in order to charge them, nothing is easier than to entangle with the vaccine, blood which may have become mixed with it, and which henceforth, it will be impossible to recognize in it. In bringing the two plates together, we shut up in the enclosure the vaccine, granulations and serum, epithelial cells, often blood and air; in a word, all that is necessary to favour, at least, to permit maceration—nay, putrefaction of the contents. In vain shall we have fastened, stopped up, sealed the edges of the plates—all that will not prevent the entrance or the action of air. And that is so true, that if after some days we separate the plates, and the interposed matter remain fluid or nearly so, which seldom happens, there arises a mouldy smell, scarcely a doubtful sign of the commencement of putrefaction. But if, on the other hand, we find it dried, we may well ask what we have gained by allowing desiccation to act slowly in a macerated product already more or less altered, in preference to making use of immediate free desiccation under the influence of a moderate heat and of rapid evaporation of the liquid elements, as is done in the case of ivory points, of which we shall shortly speak. Let us add to all that, the complicated mode of preparation, of sealing, of the package of glass plates, if we wish to send them by post, and we shall find that nothing is wanting in the recapitulation of their imperfections.

One word more on this subject: M. Fonssagrives* has recently remarked "that vaccination practised with vaccine collected from a well-chosen vaccinifer, is a hundred times better than vaccination from plates, which, devoid of a well-known and well-established scientific origin, ought to be placed on one side as dangerous and suspicious."

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* *Gazette hebdomadaire*, 4 Nov. 1867, p. 695.

In spite of that, the traditional "plate" has still its partisans. Much good may it do them. Only let us beg them to eliminate from their routine practice, that which is its principal danger: by adding to their little pool of vaccine, a droplet of glycerine, which they must mix well with it, they will preserve it from putrefaction, and, the glycerine being a stable body, they will find it fluid, or at least soft, after a very long while.

21. *Ivory Points.*—These constitute, in every respect, a useful mode of gathering, sending, and preserving vaccine. These are little ivory plates, cut square at one end, pointed at the other, generally 6 millimètres wide by 36 long. The pointed end is thinned and pared on both sides, very sharp at its tip, so that in case of need it may itself serve for the *act* of vaccination. This practice is intrinsically good, since it entirely obviates the inconveniences of the possible contamination of instruments used for various purposes; ivory instruments are always inconvenient, however, as they do not admit of making clean incisions.

We dip the end of these points, for a length of 4 or 5 millimètres, into the liquid of the opened vaccine-vesicles; then we dry them rapidly, either in the sun or before a bright fire, not placing them in a temperature of more than from 30° to 40° Centigrade, so as not to spoil the vaccine in the fluid which bathes them. It thus escapes all maceration, in the same way as preserves of pots dried upon wicker grates, which defy the ravages of time. If the point be not intended for early use, we smear the part covered by vaccine with a layer of mucilage of gum arabic, acting as a varnish, to preserve it from the action of the air and its impurities.

Thus prepared, dry vaccine keeps for a very long time. For expedition, we fix the point through a label carrying instructions as to the mode of using it, we slip it into an envelope, and throw it into the post. There is nothing more simple.

Mr. Darke, of London, has recently contrived a little instrument, which he has patented in England and America, and which is only a large toilet-needle with a glass head, with these differences, that the point is lance-shaped and the glass head is flat. It is upon this plane surface that the vaccine is placed, and where we dry it as is done with the ivory points. We make the scratches with the point, we place on these the vaccine, then we throw away the instrument, in order that for perfect safety, it may be used only for a single patient.

In order to use either the ivory point or the Darke pin-points, we soak it in luke-warm water to soften the vaccine, then we rub the latter upon the scarifications. We then collect the whole (of the liquid) upon these, and leave it to dry.

22. *Glass Tubes.*—From 9 to 10 centimètres long, the glass tubes generally employed are capillary and enlarged at the centre. This arrangement combines the advantage of sufficient capacity with a fineness of the ends favorable to capillary action, and capable of being easily melted in the operation of sealing at a lamp. When commerce delivers them to us, the two extremities are closed, in order that impurities and particles of dust

may not come to obliterate the lumen. At the time of using, we break the two ends; one of them is placed opposite a droplet of vaccine from a vesicle which we have just opened; the liquid runs in, especially if we incline the tube in such a way as to favour capillary action by adding to it that of gravity. The tube filled, we close it by holding the ends in the flame of a candle or spirit-lamp.

Tubes with a central enlargement have, over strictly cylindrical capillary tubes, only the advantage of being, on account of the fineness of their narrowed ends, more easily closed by heat. Cylindrical capillary tubes have always thicker walls, necessitating prolonged exposure of the glass to the flame, which is prejudicial to the life of the vaccine-germs.

"When we vaccinate," says Bousquet, "we break off the two ends of the tube, we adjust to one of them a glass tube or a straw, and blow gently on to a glass plate, on which the vaccine spreads, and from which we take it with the lancet in order to inoculate. It is easier to empty the tube upon the arm itself, on which we have just made scarifications to receive the contents. We thus lose less, and the whole of the vaccine arrives at its destination."

M. Fiard has invented a little tube 5 centimètres long and half a millimètre in diameter, open at one end and terminated by a small bulb at the other. This is how it is used:—We begin by rarefying the air contained in the bulb, with the fingers or in the mouth. That done, we take it by the stem between the thumb and forefinger, and we point it by the other end at the surface of the vesicle. At this moment, a condensation of the rarefied air of the bulb happens through the difference in temperature of the outside air, and the vaccine is drawn into the tube in greater or less quantity—that matters little; we must not think of filling it. The manner of sealing is the same as for ordinary capillary tubes, except that there is only one end to close—that away from the bulb. The mode of emptying the tube is still more simple: break the point and heat the bulb, you will soon see the vaccine move and escape from its prison by reason solely of dilatation of the air. The sensitiveness of the instrument depends only on the size of the bulb and the smallness of the tube. All that reminds one of the thermoscope, or the differential thermometer (Bousquet).

These tubes seemed forgotten, when M. J. Bineau* reintroduced them, believing he had invented them. "I freely confess," he writes to us, "that I believed the idea my own. I have since learnt that M. Pasteur employs no other tubes for the preservation of his viruses."

What is the value of tubes as a means of preserving vaccine? Let us hear what Bousquet says:—

"After having made use of the plates," says he, "the Central Committee adopted the tubes, and I doubt not that the authority of its example has contributed greatly to bring them into favour. The vaccine may, indeed, be preserved for a long time in them—ten, twelve, fifteen months, or more; but to say of a thing that it may be, is not to say that it always or often happens.

"Scarcely had the Academy taken up vaccination, than I was struck with the small success of its supplies of vaccine to the country. To what, did that point? We could not contribute it to the unskilfulness of those charged with the preparation of these supplies; the Academy had taken the trouble to retain those attached to the old Committee. There was no difference, then, in this respect.

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* *Le Lyon Medical*, 18 Septembre 1881.

"However, the Sub-Committee especially entrusted with the care of this precious store, ordered an inquiry. It nominated M. Burdin, one of its members, who desired my co-operation. We vaccinated together, and for purposes of comparison, an equal number of children, some from arm to arm, others with vaccine preserved in tubes. The difference in the two modes was apparent in the result; the second produced about half as many vesicles as the first, although the vaccine in the tubes had not been taken a month.

"Following up this scale of degeneration, we find that vaccine deteriorates rapidly enough in the tubes; and if there were not exceptions in everything, it would be easy to state a period after which it loses all its properties.

"I do not know what happens in the capilliary tubes, but I have very often observed, that, when one keeps them a certain time, the vaccine disappears little by little; then, one is greatly astonished, at the end of five or six months, to find them nearly empty. My first idea was that they were badly sealed, though that was not apparent to the eye. I have adapted a glass pipe; I have blown, and the vaccine has not moved.

"What becomes of it, if it does not pass out; Can we admit that it evaporates, and that the product of evaporation remains as 'gas' within the tube? There is no sign of it. I conclude from this fact, and from others, that vaccine in tubes undergoes changes which can only be fatal to its properties."

We, as well as Bousquet, have observed these changes, and perhaps observed them more carefully than he. As for that, we have collected the vaccine from many vesicles in a number of children, into large-sized tubes capable of holding at least as much as twenty ordinary-sized tubes. Then, this is what we have observed: although the tubes were full of the clearest vaccine, hermetically sealed in a spirit-flame, at the end of two or three days, we have found the liquid already clouded, become milky, with little white clots forming, large or small, the smaller ones sticking to the walls of the tube, the larger sometimes occluding its whole lumen. If we now empty the tube, we find that the vaccine has acquired an odour more or less distinctly mouldy, which becomes putrid if we wait a little longer. A parting is formed; the solid elements are grouped about it in such a way that, under the microscope, we find them brought together in a mass, in a place of being distributed.

If we use this vaccine with a lancet and operate by punctures, we risk more and more the chance of charging (the lancet) only with serum, and of making fruitless vaccinations. That already explains, without its being necessary to fall back upon maceration or putrefaction to explain them, the numerous failures referred to by Bousquet: *nearly half more than by arm-to-arm vaccination, although the vaccine had not been preserved more than a month!* To diminish this proportion, we may advise that the tube be rolled rapidly between the fingers at the moment of using, in order to cleanse its walls, and that then the whole be turned out upon the scarifications made for the purpose. We shall thus have a chance of succeeding better, for the whole of the contents will have penetrated and been useful; but there remains this uncomfortable *mouldy smeil,* to which we cannot show ourselves indifferent.

A great Belgian chemist (M. Melsens) wishing to procure perfect closure (of the tubes) without having to fear the action of too high a temperature (sealing by means of the spirit lamp), or the formation of empyreumatic products (sealing with wax), has devised the following process:*

"We make use of capillary tubes with sufficiently thick walls; we collect the vaccine in the ordinary way, and when a convenient quantity has been introduced, we cause it, by means of a few shakes, to run into the tube in such a way, as to leave a little column of air at the orifice. Then, we plunge this end into a drop of pure water placed upon a suitable plate, and we incline the tube to make the vaccine run. The water enters by means of the slope given to the tube and by means of capillary action; but the vaccine remains separated from this column of water by the little cylinder of air interposed.

"We cease adding water when the vaccine has been forced to within a few millimètres of the dry end, and which we must not allow it to reach; then we close the orifice by introducing it into the flame of a little spirit-lamp or the edge of the flame of an ordinary candle, which answers perfectly. The closure obtained by fusion of the glass leaves no doubt as to the perfect and unalterable sealing; the slight conducting power of glass prevents the heat from coagulating or altering the vaccine placed at this end of the tube.

"We then perform the same operation at the other end; the water has rinsed this part of the tube and carried with it the trace of vaccine deposited upon the walls;

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* *Journal de la Société Royale des Sciences médicales et naturelles de Bruxelles*, t. liii. p. 525, Déc. 1871.

at the first application of heat, a little explosion due to the watery vapour which forms, drives away the latter in part, and we then obtain complete sealing, without producing any trace of empyreumatic products.

"If natural liquid vaccine can be preserved, when it has come into actual contact with air, we are certain, in operating as has just been described, to have done away with all possible causes of change, arising from a closure, often, if not always, incomplete; the proceeding described, with the exception of the use of an elevated temperature, places the vaccine under the conditions of *conserves d'appert;* the conditions of preservation are even better in this instance, since we avoid the use of stoppers, of wax, of soldering and of metals, glass being unalterable.

"It may be asked, with respect to the preservation of virulence, whether tubes thus prepared do not, to a certain extent, resemble bodies, dead from infectious diseases (typhus, &c.), shut up in leaden coffins and hermetically sealed by metallic soldering. We know that, in disturbing graves, accidents happening to the coffin, have produced in the workmen the same disease that caused the death of the corpse enclosed. One is compelled, reasoning by analogy and induction, to say that the *virulence*, or the special *infection* which had attacked the living, had been preserved, with its special properties, in this corpse, which diffuses it and attacks afresh with the disease to which it has succumbed, the living beings exposed to its emanations."

M. Melsens having received, on November 25, 1871, four small tubes enclosing human vaccine, decanted it, added to it about ten times its volume of water, and introduced this mixture into five new tubes, which were sealed as usual in the spirit-flame. On June 24, 1874—

that is to say, three years and a half afterwards—this vaccine was still active; of six punctures which had been made, there was one which gave origin to a perfectly characteristic vesicle.

The manner of operating—by the puncture—and the great proportion of the diluting water, explain sufficiently why only one out of six insertions was successful. The fact of the long preservation of the germ remains, nevertheless, indisputable.

This fact is interesting to record, and justifies us in the care we must take in preserving, in order to enable vaccine to retain its virulence for any considerable time. The procedure of M. Melsens should be remembered; it may sometimes be useful.

For ordinary use, so many precautions are unnecessary. Here is the best course to follow, in order to give to vaccine in tubes, all that it is possible to give and to preserve it with certainty from putrefaction—it is that which Dr. Edward Müller, Director of the Vaccine Establishment at Berlin, has long recommended. We place in a watch-glass, a mixture of purified glycerine and distilled water, in equal parts. In this liquid, we receive the lymph obtained from the vesicles. The distilled water is used in order to make the mixture more fluid, and to allow of its introduction into the small tubes. The lymph does not dissolve easily in the glycerine, and it is well, before using it, to facilitate the mixture by means of a pin."

M. Müller estimates that we may thus, from the vesicles of a child, collect a quantity of lymph sufficient to half fill a watch-glass, in such proportions that the lymph constitutes about a fifth part of the vaccinating solution thus prepared. M. Müller has been able, as far as that goes, to dilute the lymph with ten times its weight of glycerine, and to inoculate it with success.

We never advise anything of that sort; confidence in the proportion of successes can only result from the quantity of pure vaccine in the mixture. We engage to do this with equal parts, and no further. The pool thus obtained, being very fluid, the liquid rapidly runs into the tube which we present to it. We close it by the cold method, following the plan of M. Chambon, by thrusting the two extremities of the tubes into little cylinders, prepared by melting together three parts of paraffin and one of suet. We at once see a short column of this mixture rise in the tube. The closure is satisfactory; to make it a little more solid and to finish up, we plunge the two ends, *secundum artem*, into an ethereal solution of caoutchouc, which is termed, commercially, *capsulage artificiel.*

If we wish to prepare tubes with a view to prolonged preservation, we have recourse to the following procedure, which is but that of M. Melsens', improved: We oppose the tube first to a drop of pure olive or sweet almond oil, which we allow to rise until a column about half a centimètre high is formed; then, to the vaccine, which drives the former to within a centimètre of the other end; then, once again, to the droplet of oil, which sends the first to the end of the tube. We seal in the lamp. The vaccine is thus enclosed between two columns of oil, which preserve it both from evaporation and from contact with the air, even though the sealing by the lamp be imperfect, which too often is the case.

22. *Inoculation with preserved Vaccine.*—M. Bousquet, in the book which for more than thirty years has

been the gospel of the vaccinator, lays down, so far as concerns the mode of vaccinating, various aphorisms, from amongst which, we select the following:

"1st. Procure good vaccine, it is the important point; then puncture as you please, we shall not be uneasy as to the result.

"2nd. If the lancet be well charged, it is needless to charge it afresh for each new puncture, each fresh scratch. The *quantity* of vaccine adds nothing to the result; whether it be little or much, what matters?

3rd. If the vaccine used be in a clot or dried, we must moisten it and reduce it to the fluid state with some drops of fresh water, then insert it, taking care to leave the lancet *in situ* for some seconds.

"4th. I maintain both incision and puncture to be good, and almost equally so."

These precepts are indeed only applicable to arm-to arm vaccination, to vaccination performed with vaccine, which, for facility of expression, we shall call "living." When we use *preserved* lymph, we must hasten to forget them, or rather to practise the converse of them. Thus:

1. Take a good preparation; satisfy yourself, if it be fluid, that it exhales no smell; then use it in such a way that it shall be placed in the epidermis, in contact with large absorbing surfaces. To that end, apply it over numerous scarifications, and be sure, by using moderate friction, that it penetrates well. *Guard against being content with punctures*, or you will reap only disappointments.

2. The *quantity* of vaccine introduced considerably influences the result. If only a little penetrates, it is probable that the vaccination may fail.

3. If the vaccine be dried (vaccine on points), we must soften it by steeping the point in tepid water, and make abrasions or scarifications with it; if blood appear, allow it to dry, then rub the flat surface (of the point) over the scarifications, for a sufficiently long time, only ceasing friction when the ivory has lost all its vaccine. If blood gets mixed, let everything be collected over the scratches and allowed to dry.

4. *We maintain that puncture should be avoided.* Scarifications should be used, to the exclusion of every other mode of introduction.

These precepts are dictated by this undeniable fact, that in preserved lymph, the active principles have suffered, that some have perished, and that in order to ensure the arrival of a sufficient quantity at its destination, we must open wide the door. Add to this, that, in preserved vaccine, whether it be dry or liquid, the virus granulations are grouped, instead of being uniformily distributed throughout the mass, and there is the probability of finding the lancet-point charged with little or none.

What shall we say after that of those inventions, which tend exclusively, in view of preparing for threatening deficiency of human lymph, to distribute it as scantily as possible, spreading it by means of a brush over the points of a multitude of needles, and allowing it to dry there, to make it serve according to need for vaccinations or re-vaccinations? This is a deplorable practice, the fruit of those precepts of Bousquet, which we have recited above, and which make no distinction between "living" and preserved vaccine.

We do not know how to repeat it sufficiently: vaccination by means of preserved lymph can only compare with that from arm-to-arm, by supplementing quality with quantity. What if it were called to serve as the basis of a public service of vaccinations or re-vaccinations, and the dilatory ones wished to keep to their old routine of practising punctures, there would be many fruitless vaccinations, a remediable error it is true, in a certain measure, in the case of vaccinations, but one which we could not avoid with too much care, in *re*-vaccinations, where security must be as absolute as it is possible to make it.

We must then ABSOLUTELY introduce preserved vaccine LARGELY into the scarifications. It is sufficient, as a rule, to make slight scratches with a pin or a needle. But, however simple the operation may be, there are still many practitioners of the old stamp, who, fanatics on *puncture*, still find a weapon to attack the more recent and more correct practice or scarifications; they still find it (scarification) difficult of execution, and, in fact, make *incisions*, sometimes too little, sometimes too big ; here too superficial, there too deep.

To help these unskilful ones, M. Niné, a Belgian military surgeon, has invented a very ingenious instrument. We shall speak of it when we treat of animal vaccination, for the practice of which it has been manufactured.

CONCERNING ANIMAL VACCINATION.

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CHAPTER I.

DEFINITION, OBJECT, AND REASONS FOR THE PRACTICE OF ANIMAL VACCINATION.

1. We have given the name of *animal vaccination* to that which is practised with the aid of vaccine, cultivated in members of the bovine race. It is a conventional term; the vaccine from a child is as much *animal* as that from a heifer.

Animal vaccination seems to be a recent invention. Who could say that positively? We have it from the lips of an old practitioner that in his youth, he had seen his father—the village doctor—inoculate the nipples of a cow with human vaccine that had been preserved through the winter, in order to renew the stock of fresh vaccine at the re-commencement of each vaccinating season. Others must have done the same.

We know also that, during many years, Doctor Vy (of Elbeuf) performed animal vaccination on a large scale, by inoculating calves with human vaccine, and that the same method has been made use of for a long period in many parts of Germany, and especially in Bavaria. That has been called *retro-vaccination.*

The meaning which we must nowadays give to the words "animal vaccination" is more restricted. *Animal vaccine is the product of natural horse-pox or cow-pox which has been cultivated on heifers, and has never quitted that soil.* Thus defined, animal vaccine is of recent date. History informs us that it was practised in 1800 by Duquenelle at Rheims, and by Valentin, at Nancy; that it was introduced into Naples in 1810 by Galbiati, and that from this period it developed there, to be taken up later by Négri, his pupil. A tale is still told how formerly, the Queen of England sent to the latter, from Scotland, a cow attacked with spontaneous cow-pox, in order that he might use it to renew his vaccine; but nobody says that Galbiati ever did anything but retro-vaccination.

Should we reproach him for that? We shall be careful not to do so. Our own theory of the unicity of vaccines, forbids it. We know that natural horse-pox loses a portion of its virulence by its transference to the heifer; in a similar way, the natural vaccine of the heifer may be deprived of some of its activity in passing to the child. But nothing hinders us from believing, that, carried once again to the cow, human vaccine might develop in such manner as to exhibit again all the qualities of cow-pox, in the same way as the latter may rise again to the dignity of horse-pox, when retransferred to the horse. It is a question of soil. We have, therefore, no reason to object to the practice of retro-vaccination, remembering always that a cultivation carefully performed, may have assured to the products of emigration, the restoration of their original activity.

Let that be as it may, to avoid any doubtful interpretation of a question still much discussed, we shall in this chapter allude to animal vaccination, only in the restricted sense which we have previously attached to these words.

Thus comprised, animal vaccination is, in fact, a new method; it was, indeed, only at the close of the year 1864, after Professor Palasciano, of Naples, had attracted to it the attention of the *savants* met at the Medical Congress of Lyons, that the question was brought under serious consideration. In 1865, Dr. Lanoix, of Paris, after having, during several weeks spent at Naples, followed M. Négri step by step in his practice, brought from Naples, a heifer which had been vaccinated there by the latter. On the way home, at Lyons, he vaccinated a heifer and several children from the product of his vaccinifer. Then, on his arrival at Paris, he had the great kindness to send to us, at Brussels, a heifer vaccinated by himself, which was the origin of the Vaccine Institute which we founded in 1865. This passed, in 1868, into the hands of the Government, under the name of *The State Vaccine Institute,* and we undertook the direction of it. In 1882, again, it became an adjunct of the State Veterinary College. We, for our part, maintained it as a private establishment, and it still exists under the name of *The Vaccine Institute of Belgium.*

From the institution, at Paris, and from our own, arose numerous branches, which blossomed into the various establishments for animal vaccination, that are now at work in most of the large towns in Europe and America.

In all civilized countries, vaccination is accepted and put in practice as the most certain, and indeed the only, preventive of small-pox. In vain, from time to time, do sceptics raise doubts as to its efficacy; their opposition serves only to render more active and more convincing, a truth henceforth settled. As a rule, the objections made to vaccinations are of two kinds: on the one hand, it would tend to shut up in the organism, diseased principles, which an attack of small-pox might expel: it might thus give origin to other diseases just as severe, whose development it would be desirable to avoid. On the other hand—and this is directed, especially, to the public—it would present in addition, the great danger of exposing patients vaccinated to being, in the act of vaccination, impregnated with constitutional diseases, with which those furnishing the matter for inoculation might be affected.

Justice has long ago been done to the first of these objections; as for the second, we are bound to receive it as established, at least in so far as concerns syphilis, and we cannot decline to give satisfaction to those who, notwithstanding that vaccination is rendered obligatory by law, experience objections whose legitimacy could not be equitably disputed. The occurrence of contagion, indeed, although considerably exaggerated by the mistrust of the public, nevertheless shows itself from time to time in practice.

We have more than once been reproached for having quoted this in advocating our subject. The reproach is undeserved. We have stated that it was an element of the question to which we were bound to give great attention, and we repeat it. Wherefore should we say otherwise? Is not the confession in all our consciences, and ought we, in refusing to explain it, to believe ourselves in safety, like the ostrich when it has hidden its head under its wing?

We shall do nothing of the sort. Everything that has thrown light on the subject is adduced to interest our readers. It is, then, to the accomplishment of a real duty that we devote the following paragraphs.*

2. *Vaccino-syphilis.*—This question gave origin, in 1864, to an exhaustive discussion amongst the members of the Academy of Medicine of Paris. It was an attempt to discover whether vaccine from a syphilitic subject, might, with impunity, be inoculated on a healthy person. Thus placed, the question appeared as though it should promptly have been decided in the negative. There was, in fact, but one opinion as to the indispensable necessity of surrounding the practice of vaccination, with every possible guarantee; but it was asked, at the same time, whether no danger to the traditional inviolability of the practice invented by Jenner, would not attend a loud-sounding inquiry. Is syphilis at our gates? cried they; does it threaten to invade our domestic hearths under cover of vaccine? would it not be imprudent to make a fuss concerning this beneficient institution, and thus to compromise the lively faith which society and the medical world have in it?

The Academy would not allow itself to be affected by these considerations, and did not wish that the facts which crowded in from all parts should be covered up, thinking justly that to know a danger is the surest method of avoiding it. Besides, it had a past to efface. Had it not, in 1830, said to all the vaccinators of France: "Vaccinate without fear, vaccinate always, for the vaccine virus taken from subjects afflicted with complaints susceptible of being communicated by contagion, such as syphilis, does not convey any such germs, in any case, and gives origin only to vaccinia." Could it consent that such a dogma, upon which a whole generation of doctors had leaned for thirty years, should continue to be proclaimed without appeal, when a succession of facts, upon whose significance doubt could no longer be placed, came constantly to contradict and condemn it?

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* Warlomont, Lecture on Vaccino-syphilis and Animal Vaccination, delivered at the Royal Academy of Medicine of Belgium, June 30, 1866 (*Bull. de l'Acad. de Méd.*, 1866, t. ix. No. 6).

The discussion then opened bravely: not a theory, not an observation was neglected. All the facts stated were so scrupulously examined; some amongst them were found to be so far above any possibility of doubt, that, at the end of the debate, every one agreed to accept vaccino-syphilis as an incontestable fact, rare it is true, but something that it was out of the question to dispute. It was then that we heard the illustrious ex-surgeon of the Hôpital du Midi make this declaration, which will emphasize his long and glorious career: "At first, I denied the possibility of the transmission of syphilis by vaccination; but facts repeating themselves, and becoming more and more confirmatory, I admitted with reserve, and even with repugnance, this mode of transmission. To-day I do not hesitate to state it as a fact."

This declaration by M. Ricord was of great scientific importance. It was known that proofs and evidence would be necessary to affect his almost immovable convictions. It was known that the inquiry, pursued under his eyes, could not have left in the shade, any circumstance of interest, and for the future, the question might appear decided.

It has not been so. "Let," cried the objectors "an exact description of a single case of syphilis produced *by vaccine,* be given; let it be demonstrated in this case that it is indeed syphilis that has been observed, and that the vaccine only has had any chance of producing it, and I will own myself convinced." In presence of this demand, there remained only to recommence the debate, and that is what we are about to do.

Many years passed in the apparent security created by the instruction evolved, in 1830, from the Council of the Academy of Medicine in Paris. I say "apparent," for, at the same time that the inocuousness of vaccine was proclaimed on all sides, there was not a mother who did not claim for her child, a doctor for his patient, the condition that the lymph should be taken from a pure, immaculate source. One then held in constant suspicion, as before, all lymph collected from any source which did not present its two or three degrees of constitutional purity. This traditional, instinctive mistrust must have had its results, for, whilst vaccinating with their wonted skill, many doctors contemplated the possible dangers of vaccination, and accumulated evidences to bear them out. Hence, came the reaction of 1860, still young as we see, but young only in years; for, as the result of a collection of facts carefully accumulated, it should not have long to wait for development and importance. In fact, as until then, one had been careful to hide even from oneself—so great was the influence of what had been decided—the accidents to which vaccination might be liable, so now that the idol was broken, one was impelled to publish the facts acquired by observation, timidly at first, but gaining courage under the impetus of the active champions who threw themselves into the controversy.

I will not here unfold the long catalogue of cases of vaccino-syphilis from this time forward, reported to the scientific world. Those who might be desirous of learning all their details, will find a description of them in a monograph published in 1860, by M. Viennois,* and in a work by M. Depaul, dated 1865.† More than 300 cases of vaccino-syphilis are there described. All have been examined with care, and if any among them may be excluded for want of being sufficiently exact, the greater part evidently deserve to be accepted.

It is not to be said on that account, that I expect to see them admitted without reserve. If vaccination be sometimes followed by the symptoms of syphilis, I may be told that it is because it has been practised upon the children of syphilized subjects, who, to hide their troubles, waited for the general reactionary movement which vaccinia entails, and in virtue of which the cutaneous functions become active, to bring about the exhibition of the signs of a diathesis, until then latent, or incompletely developed. We ourselves can cite in this connection with much reason, the case of a child vaccinated by M. Friedinger, of Vienna, and quoted by M. Viennois,‡ which, very soon after a "regular" vaccination, had developed a confluent bulbous syphilide, although at the time of vaccination, it had all the appearances of the most blooming health.

In order that this objection should have weight, it would be necessary to admit that all subjects who have shown symptoms of syphilis after vaccination, should already before its performance, have been affected with the syphilitic diathesis. Let us see, then, what happened in one of the cases whose history has made most stir—that of Professor Gaspard Cerioli:

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* Viennois, De la transmission de la Syphilis par la Vaccination (*Archives générales de Médecine*, 1860, t. i. p. 640; t. ii. pp. 32, 297).

† Depaul, La Syphilis Vaccinale, devant l'Académie Impériale de Médecine de Paris." (*Séances de Décembre* 1864, Février et Mars 1865).

‡ *Loc. cit.* t. i. p. 647.

"A little girl of three months (a foundling) was vaccinated with vaccine taken from a healthy child who remained healthy. Normal vesicles developed, and were used to inoculate forty-six children. Six of these latter had normal vesicles, from which a hundred other children were inoculated, who subsequently showed no sign of syphilis. Amongst nearly all the others, were observed, at the spots were the punctures had been made, ulcerations covered with permanent crusts, or indurated ulcers. These accidents supervened from the period of the fall of the vaccine scabs. Later, there appeared ulcerations of the mouth and of the sexual parts, scabbed eruptions upon the scalp, copper-coloured spots, attacks of ophthalmia, all symptoms which were communicated to the nurses and mothers of these children."

Well! if in this instance, we reject the vaccinal origin of the symptoms accused, we must admit that forty out of the forty-six children referred to, were affected with syphilis previous to vaccination, a proportion truly inadmissible. As a matter of fact, what do we find in Paris? asks M. Devergie. In the service of the Institute of Nurses, in the course of a year 2,200 children are entrusted to 2,200 nurses, and among this number, we can scarcely establish the presence of two cases of congenital syphilis in a year. These children are soon sent to establishments in the country, where other nine or ten cases of hereditary syphilis develop;

altogether twelve or thirteen, say fifteen, cases among 2,200 children. See then at what proportion we arrive and compare this number with forty children syphilized out of forty-six, in the evidence of Gaspard Cerioli.*

But there is another argument powerful in a different way. In nearly all the cases of vaccino-syphilis that have been collected, the initial lesion has been an *indurated chancre*, located at the point of puncture, and soon followed by the whole of what has been termed the syphilitic constellation. That is so well established, that in the description of it which he has given us, M. Rodet says, in accurate terms: the vaccino-syphilitic chancre has the characters of the *indurated* chancre, accompanied by the characteristic indolent adenitis.† Then, if it be true, as one of the primary aphorisms of the Ecole du Midi states, that *the pox repeats itself*—that is to say, that an individual, afflicted with constitutional syphilis, acquired by hereditary or by an indurated chancre, is not in a state to contract another indurated chancre, in the same manner as a subject recently vaccinated can no longer produce a vaccine vesicle; if that be true, I say, it is clear that individuals affected with vaccino-syphilis, represented by a syphilitic induration on the arm, were not afflicted with syphilis at the moment of vaccination, since in that case they would only have been able to develop manifestations foreign to the characteristic induration. All these subjects were then, from that fact alone, free from any suspicion of previous constitutional syphilis, which the act of vaccination would only have served to render active.

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* Discussion sur la syphilis vaccinale à l'Académie de Médecine de Paris (*Séance*, du 14 Février 1865).

† *Gazette Médicale de Lyon*, 1866 p. 160.

The excessive rarity of cases of constitutional syphilis, in comparison with the prodigious number of vaccinations performed during twenty-four years, is another argument which should not be lost sight of. But we must not forget, that, under the influence of fixed ideas relatively to the non-inoculability of secondary syphilitic accidents, not a doctor was disposed to believe his eyes, did he find himself in presence, even of the most pronounced case of vaccino-syphilis. And if it happened by chance that a mother accused the vaccine of a fault of the kind, were we not all too ready to treat, as idle stories, complaints perhaps too true? How many cases have thus been denied an examination, to which they had a right? We know, besides, that syphilis progresses more slowly than vaccinia, and that, very frequently, the vaccinated ones are already far away, when the specific accidents show themselves; they thus escape rigorous and impartial observation. Many physicians will tell you, that in their long career, they have annually vaccinated hundreds of children, without having ever had to note accidents that could be imputed to the operation. But how often have they seen these children again, in the country especially, or in the dispensaries, after having inoculated them? The greater part escape all observation, and if, later, syphilitic symptoms are manifest in any among them, doctors believe themselves authorized to place these without question to the account of an anterior diathesis, too happy in thus avoiding a well-marked responsibility, to even question her whom the doubt might have affected.

One word more, on this matter. On November 29, 1864, M. Depaul, Director of Vaccination at the Academy of Medicine of Paris, in his scheme of the report to be presented to his Excellency, the Minister of Agriculture, Commerce and Public Works, said: "The Academy can refer to its experience, which is one of the most extensive; it procures the benefits of vaccination for 2,000 to 3,000 individuals each year, and, to this day, it has not had to show a single case of vaccino-syphilis developed amongst them." This was an unfortunate speech, for scarce had nine months gone by, than the contrary chance knocked in its turn, at the gates of the vaccine department of the Academy.

*Obs.**—M. A. X., twenty-seven yeras old, who had never had any venereal troubles other than two severe attacks of gonorrhœa, while preparing to go to Frankfort to see his father who was suffering from small-pox, came on August 19, 1865, to the Academy of Medicine, where he was re-vaccinated in the absence of M. Depaul, by another person, who made six punctures, three on each arm with a needle charged with vaccine taken from a child of about six months, pale and of meagre aspect. The same day, several children and several soldiers were vaccinated with lymph from the same vaccinifer. M. X. does not know whether the vesicles of the vaccinifer contained blood or not. Four vesicles resulted from the six punctures made, two on each arm, at the site of the two higher punctures. They were examined at Frankfort, by a doctor who thought them of good character. The scabs fell on September 12.

On his return to Paris, M. X. observes, about September 20 (a month after the vaccination), the presence of two new elevations, at the level of the two punctures, which till then had remained unproductive; these soon changed into dry, brown scabs. A month later, about October 20, he begins to experience very violent pains in his head, especially marked at night, "*as soon as he places his head on the pillow,*" which prevent sleep, and also, some vague pains in the chest. Two or three days afterwards, some slight red spots, unaccompanied by itching, show themselves on the anterior aspect of the chest and abdomen. The pains in the head become so severe, that he goes on November 6 to consult Dr. Millard, for what he calls his rheumatism in the head, and for the general *malaise* from which he is suffering. After a somewhat superficial examination, M. Millard was about to prescribe some anti-neuralgic treatment, when M. X. happened to speak incidentally of his re-vaccination, and of his two slowly developed vesicles, whose scabs, said he, had not yet fallen, seventy-eight days after the operation.

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* Millard, Physician to the Hôpital Saint Antoine (*Union Médicale*, Decembre 1865, No. 147, p. 466).

This was a ray of light for M. Millard; he, at once, caused his patient to undress, and discovered, at the upper part of each arm, a thick brown scab, below two recent cicatrices of normal vaccination. The scab on the right arm, did not differ sensibly in its size, its brown color and its thickness from legitimate vaccine scabs; but that on the left was much larger, of conoid shape, of dark greenish-black color, very thick, and as though formed of several scaly-layers: it reminded one of the scabs of *rupia.* It was difficult to feel any indurated base underneath these scabs, but so soon as they had fallen, the induration had been plainly perceived. Further, in each axilla were felt several swollen lymphatic glands, forming a veritable constellation. Then over the chest, on the arms, and especially on the lateral and posterior regions of the trunk, was a papulo-vesicular eruption sufficiently spread, absolutely indolent, presenting all the characters of a syphilide. This had not attacked the upper limbs, he had not had any sore throat, and the fauces were healthy. A single gland, slightly swollen, was felt at the occipito-mastoid region. The headache had the syphilitic character, being worse at night, affecting chiefly the crown of the head, seeming to increase with pressure, and very much aggravated by the contact and heat of the pillow.

The genital organs, minutely examined, were healthy and bore no trace of cicatrix; he had no swelling of the glands in the groins, and further, the patient, interrogated afresh with persistence, swore that he had never had a chancre.

"After this examination, I shall remain convinced," says M. Millard, "that M. X. was attacked with vaccino-syphilis; that he had been inoculated with this syphilis on August 19; that the scabs which still remained on the arms, nearly eighty days after inoculation, covered two ulcerations of a chancrous nature; that the glandular enlargements in the axillæ were the consequence of them, and must have been present some time; that further, the almost simultaneous appearance of the headache, and the cutaneous eruption on about October 22, that is to say, at the end of two months, followed out the most customary mode of evolution of the syphilitic diathesis.

"Much disturbed, and almost embarrassed by this discovery, understanding the gravity of such a fact, since it was at the Academy of Medicine that the inoculation had taken place, scarcely six months after a celebrated discussion, in which it had often been repeated, with a kind of satisfaction, that, during the more than sixty years that they had vaccinated at the Academy, thousands of children each year, they had never observed vaccino-syphilis, I determined that this should be observed by a physician whose testimony could not be called into question, and a consultation being just then possible, I myself took M. X. to my excellent master and friend, Doctor Hardy.

"After having examined and interrogated the patient, the able physician of the St. Louis Hospital did not hesitate to form the same diagnosis, and to declare that the syphilis had been inoculated in the month of August by the vaccine punctures. We ordered a mixed treatment, consisting of pills of the green iodide of mercury and a solution of iodide of potassium. This last was meant to relieve the patient as soon as possible of his painful headache. I also advised my patient at once to inform his uncle, Dr. S——. The latter took his nephew on the same evening of November 6th, to see M. Ricord. The eminent syphilographer, who, we reminded him, had in the previous January, with much vigor, controverted at the Academy, M. Depaul's report, and who had contested several observations mentioned in this report, did not hesitate to yield to the evidence and to recognize that in M. X., *re-vaccination had been the starting point of syphilis*. He, in consequence, prescribed a treatment. I have seen the patient several times since; the scab on the right arm fell on November 9, and has been succeeded by a rounded reddish cicatrix, glistening but little, and *slightly indurated*. On November 14th or 15th, the crust on the left arm separated in its turn, and gave place to a large, circular cicatrix, with a base *plainly indurated*, and similar to that of a chancre. The headache has rapidly disappeared under the influence of iodide of potassium, taken concurrently with [illegible] pills of green iodide; the eruption on the trunk, [illegible] having increased a little, already commences to fade, [illegible] it is still very characteristic. The patient continu[illegible] follow M. Ricord's prescriptions regularly, and to h[illegible] that he may soon be cured. On December 1st, he l[illegible] Paris to take up his duties at Constantinople.

"M. Depaul, since being informed of this unfortun[illegible] case, has commenced an inquiry into the vaccinatio[illegible] performed at the Academy on the 19th of August las[illegible] Nine children had been vaccinated at the same time [illegible] M. X., and with vaccine from the same child. Six o[illegible] them have been found to be evidently attacked with [illegible] syphilis; they are on the road to recovery, thanks to [illegible] specific treatment which M. Depaul himself supervises; two are dead, without our having been able to trace exactly either the cause of death, or whether they showed any syphilitic developments; the ninth child has not been found.*

"As for the vaccinifer, he had been sent to nurse into the Department of the Basses-Pyrénées, and he appeared to have succumbed, with all the signs of syphilis. The mayor and doctor of the neighborhood should be able to send exact details concerning this child.

"There remain the soldiers, vaccinated similarly on the 19th of August, with the same infectious vaccine, and of whom, there is yet no trace. We do not know exactly how many there were of them; several of them have left Paris, either to change garrison, or to go on foreign service, or to return to their homes. Nevertheless, we hope to find them. A professor from Val-de-Grâce has been good enough to undertake this difficult and delicate inquiry, and will send the results to M. Depaul, who proposes later on, to publish a detailed account of these regretable occurrences."

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* This one has been found since the date of publication of this observation. He was also syphilized.

There is the account, as it was brought forward last December, by Dr. Millard. Since then we have been able to procure the following further particulars:—Of the nine children vaccinated on the same day, and with the same vaccine, M. Depaul has traced not six, but seven. About ten weeks had passed when he saw them: all bore indubitable traces of a general syphilitic infection, all so much alike that to describe one described them all. Here is one of the observations:*—

Emile C——, aged eleven months, vaccinated on August 19, by three punctures on each arm. Four vaccine vesicles developed normally, and at the end of three weeks, had passed through their regular course. Fifteen days later—that is to say, five to six weeks after inoculation—there appeared, in two cicatrices on the right arm, and in one on the left arm, a thick elevation, which ulcerated and attained the size of a five-centime piece. On November 13, the general condition was deplorable; the cachectic state well marked, ulcers on the arms *indurated*, roseola over the whole surface of the skin, the axillary glands large and indolent, a group of glands in the cervical region, mucous tubercles behind the left ear, as well as around the anus.

This child and all the others have been subjected to a mercurial course, and under its influence, all the conditions have improved, and have ultimately disappeared.

There remain the soldiers, whose destinies had remained a mystery, and of whom three have recently been found in turn at the hospital of Val-de-Grâce, each one having indurated chancres on the arms, at the point of inoculation of the vaccine.

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* A communication written by M. Depaul.

To complete this interesting series of observations, I have begged M. Ricord to be good enough to inform me if he had really passed, on M. Millard's patient, the opinion which the editor of the *Union Médicale* attribute to him. Here is his reply, dated the 5th of this month:

"'SIR AND HONOURED COLLEAGUE,—I was indeed asked to examine M. Millard's patient alluded to in the *Union Médicale*, and I have been able to establish in this patient, as in several others, a case of transmission of syphilis by means of vaccination. At present I have only been able to see the results of this mode of contagion; I have not yet had the opportunity of verifying its sources. In all the cases, vaccino-syphilis, whatever be the conditions and the mechanism of communication, appears to be now an established fact.—Believe me, &c.,

(Signed) PHILIPPE RICORD.

"Paris, June 5th, 1866."

In presence of documents so precise, of facts so firmly established, we ask if doubt be still admissible? Indeed, nothing is deficient in the preceding observation. Was the disease observed really syphilis? It was so considered, first by M. Millard, then by MM. Hardy, Depaul and Ricord. Could syphilis have been already existent in the vaccinated, before they were submitted to inoculation? Impossible; for all of them developed *indurated* chancres following in the train of vaccination, and *the pox does not repeat itself.* Had syphilis been able to gain entrance by any other mode? Let us note that, among the eleven subjects, there were seven children, and that in each of them, as in the four adults, the initial lesion was located in the deltoid region.

There is, however, one omission—it has not been possible to produce the vaccinifer to whom all the mischief is imputed. He was dead when we wished to find him. The body of the delinquent, then, is wanting, and it might be admissible to make use of that fact. How, it may be said, can we admit a complete impeachment, when the first link of the chain is absent? Well, there is no need of this first link, for the vaccinifer might be perfectly healthy, without any portion of M. Millard's observation being found incorrect. We will explain. In multiple vaccinations by batches, if we may be allowed the expression, one occupies oneself exclusively with the interests of the vaccinated, not at all with those of the vaccinifer. We watch very attentively, when we watch at all, that the latter should not lose a single drop of blood, but we trouble ourselves but little to learn whether the lancet or the needle which has just produced a puncture, may not convey something to the vesicle from which it is about to draw anew. Perhaps the danger is very slight for the vaccinifer himself, for it is doubtful whether the vaccine vesicle is suitable to active absorption, but it is not the same for those vaccinated in the succeeding series, who will thus be exposed to a suspicious inoculation with all its consequences. Thus, in the case of M. Millard, the first subject vaccinated (other than those noted) might have poisoned the vesicle, and have been the point of origin of the whole catastrophe. Mark, that we only give this explanation as subsidiary, for *the* vaccinifer of the Academy of Medicine appeared to have died with all the symptoms of syphilis, if one agrees with the reports furnished.

Perhaps, in spite of the precision of the facts which we have just brought forward, one may meet with some ceptical spirit, resolved to dispute their correctness rather than their interpretation. This resistance to belief in phenomena which one has not had the opportunity of observing personally, and which are opposed to notions and creeds long indulged in, is too natural to be blamed; besides, in controverting as long as possible, does not one force one's opponents to formulate their theory more accurately, to support it with more exact observations? Far from arresting progress, scientific scepticism, consolidating it in a manner similar to the opposition to which governments have to submit, forces them to progress. In this matter, opposition, foreseen and announced, has compelled us to be more detailed in our explanation: truth will lose nothing by it.

Scientific denial, however, has its limit. It is necessarily the duty of the wise man, always to recognize facts well established, although that may be hurtful to his conceit. It is this that the illustrious ex-surgeon to the Hôpital du Midi has had the courage to do, after loyally perceiving that certain laws which he had taken for granted and long maintained, had recently been overturned by observation. We know that some have termed this abandonment of ancient creeds desertion, and for their sakes, we are sorry for it. Scientific principles are not articles of faith, which one could not abandon without ceasing to be orthodox. Of human origin, they are like all things human, liable to error. To wish to make of them a banner, to which one should swear fidelity, is *simply* to put fetters on progress. Let us say to those who would range themselves under such a banner: *Save us from going so far.*

If we limit ourselves to the recital of this single fact, it is because all the others—those of the Rivalta, of the Palatinate, and so many more—have been the objects of more or less serious discussion. This case of M. Millard, on the contrary, has not been disputed; that is why we have believed, it would be a useful thing to give a complete and detailed account of it.

We believe that the possibility of the propagation of syphilis by the act of vaccination, must now be considered an established fact. There remains to discover in what manner this propagation is brought about. Several hypotheses are before us.

In the first (we shall not revert to the accidental contamination of which we have previously spoken) we suppose that a child affected with the pox, is submitted to the classic vaccine punctures. May it not happen, M. Melchoir Roberts has said,* that at the moment of development of the vaccinal elevations, some superficial ecthymatous pustule, or rather a flat pustule with a pseudo-membrane on its surface, may come to be mixed up with the vaccine vesicle, to hide itself besides the latter, or take its place? In this instance, with the vaccine, one might inoculate the secretion of the secondary eruption. This supposition is the most admissible as, in a young child affected with syphilis, the least irritation—a slight scratch—may determine the localization of the malady. M. Cullerier has proved recently, in a syphilitic child attacked with ecthyma, that any scratched portion of the skin, when dried up, became the seat of an ecthymatous pustule.

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* *Union Médicale*, 1862, t. iv. p. 147.

The second hypothesis is that which makes the blood play the active part in the development of syphilis by vaccination. For that, we must admit that the blood of a syphilitic inoculated, on a healthy individual, can communicate syphilis to the latter. Observations of accidental cases of this kind were not deficient, but there was wanting a direct experiment intended to throw light on the fact, in such a way as no longer to permit of doubt.

This experiment has been performed.

Nothing is deficient in this observation; neither the merit of the master, nor the courage, nor the perseverance of the victim; the experiment was pushed as far as possible, and the proof obtained, master and pupil proclaim the result aloud, bravely making sacrifice, upon the altar of science and of truth, of all considerations drawn from human respect. May this example not be entirely lost!

An experimental demonstration could not be more complete. In the train of ideas which the mention of this has suggested to us, one might raise objection to the extent of the contaminated surface, which it had been necessary to impregnate with syphilitic blood, in order to make it fructify. Perhaps some one will say that it has never happened after a simple inoculation. Vain evasion!

The fact of the inoculability of syphilitic blood being established, the danger of introducing syphilis with vaccine, no longer needs demonstration. The danger is there; it is palpable and altogether inevitable; for if the blood is contagious, it is impossible that vaccine lymph, which rests on a surface impregnated with this *blood,* should not in its turn be to a certain extent aturated. It follows therefore, that no precaution can, with certainty, place a doctor beyond the risk of transmitting syphilis in vaccinating. Listen to what Ricord ays, on this matter;—

"The child from which we take the vaccine, may have every appearance of the most perfect health, and nevertheless, have latent constitutional syphilis. It is he same with the relatives, with the legal relatives at east; for, in syphilography, the old adage of right may ndergo some such variations as this: *is pater est quem orbus demonstrat.* There may be a concealed third arty, and the parents that one sees, are not always a fficient guarantee. After how long a period, may one ractice vaccination without risk? It is not possible to y. One may always expect to find the pox show itself uring the first six months: it is the rule; not that it ever shows itself immediately, but because in many ases five or six months elapse before its first manifesta-ons. There is therefore, no security earlier than the xth month.*

Although this last proposition may be absolutely true, e proportion previously given, appears exaggerated. hus, from the statistics of M. Diday, bearing upon 158 ses, it happens that the syphilitic symptoms have anifested themselves:

Before the lapse of	1	month	since birth,	86	times
"	"	2	months	"	45	"
"	"	3	"	"	15	"
"	"	4	"	"	7	"
"	"	5	"	"	1	"
"	"	6	"	"	1	"
"	"	8	"	"	1	"
"	"	12	"	"	1	"
"	"	24	"	"	1	"
					158	times

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* Séance de l'Académie de Médecine de Paris du 19 Mai 1863.

If, then, the chances are greatly in favour of the child who has not betrayed his syphilis, before the end of the third month, it is not less true, on the other hand, that it may remain latent, until the age of two years. Absolute security cannot depend, then, upon the age of the vaccinifer.

From what precedes, does it follow that it is necessary to give up arm-to-arm vaccination? No such idea is in our thoughts. As well might one say, that it was necessary to abandon venesection, because there had been unfortunate cases of blood-letting, or chloroform, because there had been deaths from anæsthetics. We desire simply to arrive at this conclusion: that vaccination is a serious operation, of which the medical practitioner should scrupulously reserve the monopoly; that in place of being always, as was long believed, free from all danger in so far as concerned the transmission of syphilis, such transmission, although very rare, is always possible, but it is less in proportion, as we surround ourselves with the most minute precautions for avoiding it; that in the presence of such eventualities, the surgeon shall only be relieved of all responsibility, on condition of having done his utmost to guard against all chances of danger, or of accident.

Let us summarize: it is impossible to gainsay, that the lancet of the vaccinator, whether it has been badly cleaned after being used for some other purpose, or whether it has been charged with syphilitic matter, at the same time as with the vaccine from a badly selected vesicle, may inoculate syphilis with vaccine. But to ensure that, a number of circumstances must happen, which a prudent operator will nearly always know how to avoid.

in order to admit that vaccine matter, properly so-called, might be mixed with syphilitic matter, it would be necessary to have demonstrated that the germ of vaccine, and that of syphilis, can exist together and live well in the same medium. But that has not been demonstrated, and thus cannot be affirmed. In order to allow of that, it would be requisite that in mixing syphilitic pus with vaccine, and in inoculating this mixture, that we should be able to produce a single vesicle, enclosing both viruses. Well; what we obtain in this case, if—as may happen—the two germs propagate themselves, is a vaccine vesicle and a chancre, appearing successively, the one first, the other afterwards, and running their courses separately. There is the danger from the careless vaccinator. But if, in a contaminated subject, the arm of the vaccinifer bear no inoculable syphilitic production, and the lancet borrows from the vesicle only lymph deprived of blood, it is by no means proved that the transmission may still be possible.

If it were otherwise, cases of vaccino-syphilis would be counted by thousands. It is established, on the contrary, that in those countries where vaccination has long been obligatory, and practised exclusively by special physicians, such as Sweden, Hanover, Hesse, Nassau, Wurtemberg, &c., vaccino-syphilis is entirely unknown At any rate, the prejudices of families are not less existent, and they have their grounds.

What satisfaction can it be, to be subjected to these uneasinesses, and to these unpleasant things? We have previously pointed it out. It is enough, that the vaccinator shall take care to accept as vaccinifers, only healthy and well-built children, and, especially, seeing the difficulties which surround such selection, only to charge his vaccinating instrument with pure vaccine, innocent of any admixture with the blood, or other fluids of the subject furnishing it.

3. There is then the first consideration that has to be disposed of. There is a second which it is not less necessary to pay attention to: I mean the relative poverty of human vaccine matter.

In countries where vaccination is compulsory—in England, for example—where every child, whatever the time of year, must not only, under penalty of fine or even of imprisonment for the parents, be brought to be vaccinated within three months after birth, but where the latter are liable to similar punishment, if they do not bring the child back on the eighth day and allow it to be used as a vaccinifer, deficiency of vaccine is scarcely ever experienced, and from this point of view at least, its sources do not require to be reinforced. But how often is it otherwise, in other countries where, as in Belgium and in France for example, vaccination is entrusted to the judgment of parents? and how often do they forget to trouble themselves about it? There not only do the parents, when it is their fancy, neglect to have their children vaccinated, but what is almost as serious, looking to the transferable material lost, they may refuse, if it be their good pleasure—and they do not hesitate to do it—to allow the smallest portion to be collected for the benefit of others. That is not all: there exists still, in many places, this prejudice, that it is dangerous to vaccinate children in the winter; hence, an almost complete suspension of operations from the 1st of October to the 1st of May, that is to say during seven months of the year.

We see the consequences of this state of things. If an epidemic of small-pox appears in the winter, and with it, the need of a large quantity of vaccine to meet the demands of revaccination, the virus becomes deficient, or at least, its production is not in proportion to the demand for it. The doctors at the dispensaries, the lying-in charities, the institutions for human vaccination, have to perform prodigies of good-will and activity; subjects become too few, and they are thus compelled to be less strict in their choice of productive subjects, must even distribute—who knows?—vaccine from revaccinations, which, nine times out of ten, merits no confidence, and when utilized for revaccinations, creates a security as dangerous, as all control over its results is impossible.

Thus, in parts where vaccination is not enforced by law, it is for the public utility that we should replenish the sources of vaccine, by means which shall not be at the mercy of the populace.

We have already noted, that, in other parts, this utility is not so great, since vaccinifers are rarely deficient; and that, in consequence, new methods of procedure would be but little likely to succeed, on account of any insufficiency of Jennerian vaccine.

That is but one side of the question. There is another upon which we have already insisted. In countries where it is obligatory on parents to have their children vaccinated, the State also is under moral obligation to furnish to all families, vaccine which shall be beyond suspicion, with regard to diathesic adulterations.

Such are the two failings inherent to the vaccination in use since Jenner's time, to which it was necessary to find an efficacious corrective by new measures. These correctives have been discovered, in spreading the practice of what it has been convenient to call "*animal* *vaccination,*" a method which consists in inoculati the original vaccine, upon young specimens of the bovi race, and using the product of this inoculation to vac nate human beings. This product, besides enabling to escape the danger of syphilitic adulteration, m very quickly be indefinitely multiplied, and creates th an illimitable source of vaccine matter, capable of alm instantaneously supplying the most pressing and m extensive needs.

If the new method had only this single advantage, would already have justified more than sufficiently, t eagerness with which it has been seized upon. In vai has the most formidable opposition blocked the wa Nothing has succeeded, animal vaccination satisfied want; public sentiment has very soon taken the measu of all obstacles.

4. Does the preservative power of vaccine dimini with time; in other words, may vaccine degenera and in the affirmative, should it be renewed, and what means?

This question is one of those which the Royal Acade of Sciences of France, on the proposal of a Commissi of which Professor Brechet was the secretary, opened competition, in 1838, for a prize of ten thousand franc to be awarded in 1842. That indicates the importan which, at that time already so long past, was attach to its solution.

It was only in the early part of 1845 that M. Serr communicated his report on the thirty-five essays, th this competition brought to light: the prize was divid between MM. Bousquet, Fiard, and Steinbrenner. Ea of them decided the question in the affirmative.

Although M. Brisset may be regarded with go on, from the energy and tenacity which he brought its support (1818), as the true originator of the idea t vaccine degenerates by its successive transplantations man to man, we must nevertheless not forget that, years previously, an Englishman (Kinglake) had dy expressed an opinion on the subject. In fact, a publication dated 1814,* this author advised that, equent on a certain number of reproductions in the n body, vaccine little by little lost its preservative er, in the same manner as that happens in those mitted to variolization, and recommended on that ount, that as often as possible, fresh lymph taken n the udder of the cow should be made use of.

Dr. Mayer,† again, reported that in 1817, the Sanitary mmission of the Grand Duchy of Baden, doubting the cacy of the vaccine which they were then using in t country, by reason of the great number of transmiss from arm to arm that this vaccine had undergone ring nearly twenty years, ordered that it should be ewed; for, said he, "it is useful from time to time to e vaccine from the cow itself, since human vaccine, the admixture of heterogeneous principles (*sic*), must le by little lose its preservative force."

It was in his first memoir, read on May 28, 1818, fore the Society of Medicine at Paris, that Brisset pressed his opinions on this subject. He said that on s return to civil practice, he had found a great differce between the vaccine vesicles then existent, and those which he had been in the habit of seeing, befor embraced a military career (1809). He now found vesicles much less developed, and their areolæ simil much less marked.

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* "On the Altered Specific Powers of Vaccine and Variolous er" (*Med. and Physic. Journal.* By Fothergill and Want. ember, 1814).

† "Annalen für gesammte Heilkunde." 3e Jahrg. Heft i.

It was, he said, this striking difference between vaccine eruptions of the two periods, that inspired hi in 1815, with the notion of a degeneration of the vacc virus. He continued, after this time, to make research and compared, with that object, the eruptions of t time, and the local and general phenomena which acco panied them, with the descriptions which authors the earlier periods gave of vaccinia. It was, in con quence, necessary, he said, to renew the vaccine fr time to time, in order to preserve its activity, by obtai ing it from its source—the udder of the cow.

In his second publication* Brisset has rested his sta ment upon four series of proofs: 1st, proofs found upon the analogy between vaccine virus and ot viruses, and the contagious miasmata; 2d, proofs f nished by epidemics of varioloid, which every year atta a considerable number of vaccinated subjects; 3 proofs drawn from the evident difference between t local and general symptoms then found, and those former periods; 4th, proofs drawn from the differen shown between the cicatrices of vaccinia to-day, and t still existent cicatrices of vaccinia of the earlier years.

These conclusions have been attacked and defend with equal vigor on both sides; we look up the details e discussion in a book by Steinbrenner,* who has given ng account of it. In his mind, as in Bousquet's, bt was not admissible; vaccine degenerates in passing ough human organisms, and frequent regeneration of e vaccine lymph, by taking it from time to time from e cow's udder, is the remedy to oppose to this degency.

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* Brisset: "Reflections on Vaccinia and Small-pox; having their object, the complete Extinction of Small-pox by means Vaccination."

This opinion has prevailed, and has been solemnly oclaimed anew in these latter times: in 1867, the Government, having put to the Royal Academy of Medicine of Belgium, the question, if they were able to regenate vaccine, and that dying out, in what manner they ight practically obtain such regeneration, received to it the following reply:

"1st. The Academy has already recognized the utility, nd even the necessity, of regenerating or renewing vacine, and it has not changed its opinion in this matter.

"2nd. A really practical method of securing this egeneration would consist in a large use of animal vacination, derived from the inoculation of spontaneous ow-pox on animals of the bovine race, from which the roducts of such inoculation would be constantly prerved by procedures, recently introduced into science."†

This theory corresponds to the ideas which have just een expressed. Whatever may be the origin which we may attribute to vaccinia, whether attenuated variola, or special virus, the human organism is certainly stranger to it. It is not the soil on which it was hatched.

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* Steinbrenner: "A Treatise on Vaccinia; or, Historical and itical Researches on the results obtained from Vaccinations and evaccinations since the commencement of their employment, etc." l. in 8vo., pp. 844. Paris: Labré. 1846.

† "Report on the Question relative to the Renewal of Vaccine by e aid of Animal Vaccination, put, by the authority of a Commisn, to the Royal Academy of Medicine of Belgium," M. Marinus, cretary. (*Bull. de l'Academie*, 1867, t. i. No. 3.)

So much being admitted, let us see how this soil comports itself, with respect to the variolar germ, and the vaccine germ, which may be introduced to it. The variolar finds there, by right of previous occupation, a marked welcome by means of general absorption, which restores it to the state of natural small-pox. With the vaccinal, it is no longer the same thing; in vain, is it introduced there artificially, never does it show itself with all its attributes; horse-pox or cow-pox always convey it to man. Take it from one or other of these latter conditions, and inoculate it on man: its first care is to descend a degree in the scale of virulence. Further, once descended, it never reascends to the superior grade, unless under the condition of finding once more, a soil propitious to such reascension, the body of the cow, or that of the horse.

It is natural, that, on this thankless soil, which is only a land of adoption, the vaccine germ should lose some of its activity; but if, as often happens in its migrations, it should, as a last straw, meet with sickly or unfavorable subjects, it will of necessity degenerate still more, and become, in its turn, the founder of a family, whose members will be but little fitted to give origin to healthy stocks. Thus do stocks decline, which, in spite of all the care bestowed on them, finish up by making unfortunate alliances. Thus explained, the so-called degeneracy of vaccine cultivated in the human organism, is not a condition inherent to its existence; it is merely the consequence, almost fatal, of the course which we have made it take, and of which the difficulties have not been successfully avoided. In brief, it is not the vaccine that degenerates, but the stocks that use or abuse it.

Animal vaccination, as it is now practised and commonly employed in certain countries, permits of constantly producing in man, a breed of strong and healthy products. This is one of its most certain benefits, and of all, assuredly the least contestable, and the least contested. The decline of human vaccine, under these conditions, from whatever point of view we may look at it, it is henceforth easy to avert.

CHAPTER II.

THE TECHNICS OF ANIMAL VACCINATION.

5.—I. *The Animals to be Used.* Up to the present time, vaccination, termed animal, has only been had recourse to, with animals of the bovine species.

We may choose at will, large or small animals; the latter, always more easy to handle, are generally preferred. We will first discuss them.

The calves, male or female, should weigh at least a hundred kilogrammes, and be in good health.* A red or white coat, as a rule, coincides with a skin soft and free from black pigmentations, most favourable to regular observation of the vaccine eruption. Skins, pigmented with black, lend themselves less readily to our purpose. Red and white calves are then those we must choose; if we are reduced to the necessity using black ones, at least we must insist that the regi between the teats and the umbilicus, which is about be used for the inoculations, shall be as white possible.

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* It has been said, that, during the first five or six months the animals are less likely to reproduce cow-pox. We are ignorant of the grounds upon which this assertion is based.

Males are worth no more and no less than females; the former, the scrotum is a region particularly sensit to vaccine, which there develops almost better than an where else; but, on the other hand, the position of th genito-urinary organs interferes with the preservati of the inoculated region, by means of coverings fro contact with the impurities of the litter. Among females, on the contrary, the folds which surround thi region are sheltered from direct contact with th excreta. This is an advantage from another point o view, which the persons who collect lymph, soon discover.

The stable should be well ventilated, and of mediu temperature, and during their detention here, the calve should receive, as their only food, eight or ten litres of good milk daily, according to size, besides one or two new-laid eggs. This nourishment conduces to their health, and gives to the tissues, the appearance, and other qualities, which it is important to preserve for the use of the slaughter-house.

Too often, the animals come to the stable, benumbed, unclean and distended with the water, that has been poured into their stomachs before their arrival at the market, to increase the weight upon which their price will depend. Hence, come shivering fits, the beginning of diarrhœa, and often worse. To succeed, it is necessary that the animals should rest for a day or two after their fatigues, before being submitted to the operation of vaccination. The latter, under these conditions, will *never* be the occasional cause of any morbid state whatsoever, nor of diminution in the market value of the subject.

We must indeed not forget, that, at the latest, the animal should yield all its harvest in the course of the sixth day, and that it may be killed on the seventh, before the possible development of suppurative fever, which thus never arrives, until after the animal has been eaten. As a matter of fact, it does not suffer through vaccination, however numerous the insertions may be. It may suffer from the fatigues and ill-treatment of the journey, from the manœuvres of the dealer, from the change of stable, or on account of the separation from its mother, but vaccination alone is never the cause of any depreciation in it. This may be laid down as an axiom in the matter of responsibility.

What can be the reason, then, that calves are attacked during the vaccinal period, with illnesses of a kind to make it pass through them unfavorably, diarrhœa and tympanites being prominent? Diarrhœa, if it be persistent—most often a light diet and some emollient draughts check it in a few hours—may arrest, or at least delay vesiculation; tympanites which often accompanies it, is one of its complications, and not less disagreeable. If it should begin when the eruption shows itself, the latter becomes modified at once; the vesicles become flattened, even to the point of disappearing or drying up completely. If they be full when the stomach trouble comes on, the skin, stretched like that of a drum, draws them, makes them smaller, and sometimes, in a few minutes, causes the disappearance of the whole of their contents. We must not dream of collecting the lymph under these conditions; on the contrary, we must treat the tympanitis, and wait. Often a few hours suffice to allow the skin to regain its softness, soon followed by the return of the vesicles to their normal condition.

Animals vaccinated on the abdomen—that is, the site of election—wallow in their litter, impregnated as it is with dejecta, soil in this manner both the seat and the products of the eruption, and when the latter has appeared, tear the vesicles by contact with the straw or hay. This is an inconvenience difficult to avoid, but the importance of which, we need not exaggerate. As for being torn at their surface, the vesicles need lose on that account, neither their contents, nor their intrinsic qualities. But one should not on that account, seek to avoid it (tearing) the less, as one may manage to do by placing some kind of pad over the abdomen of the animal, and by exchanging the ordinary litter for a floor, with an opening for allowing of the escape of excremental matters.

The vesicles are threatened in yet another way: the itching, which immediately follows the operation, induces the creatures to lick the small wounds, and thus to wash away the vaccine which has just been deposited there. Later on, the same irritation induces them to use the same method of subduing the irritation produced by the eruption. We avoid this means of sterilization or bruising, by applying to the beasts, as soon as they have been vaccinated, a kind of muzzle shaped like a willow basket, which they should retain during the whole time of their detention at the stable.

It is wise, for the same purpose, to obtain control over the tail of the animal, which is done by fixing it in a sort of frame, made of short sticks, rounded at both ends, and bound between these for a short distance; that prevents the animal from bending its tail, and from bringing the mouth near the region where the vaccinal insertions have been made. The basket is then unnecessary.

6. *The Vaccination of Calves.*—The day on which the animal is to be vaccinated, or at soonest the evening previous, for we must not allow the hair time to push out again, it must be shaved on the parts destined to receive the vaccinal insertions; a laborious operation, which we ought to entrust to a careful man, and for which it is necessary that the creature should be firmly fixed.

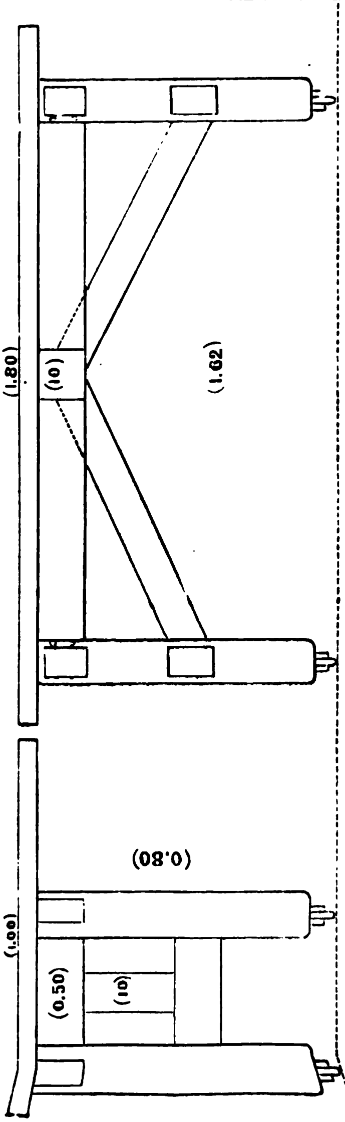
The table which we have had manufactured for this purpose, in imitation of that belonging to M. Lanoix, is represented (*see* plate p. 113) on a scale of five centimètres to the mètre. To hoist the animal on it, we place him standing against the table, rendered upright by a tilting movement, and keep him there by means of a large abdominal strap. When we then replace the table in its horizontal position, by means of a similar tilting movement, the animal finds itself stretched out, and it is now only necessary to fix him by straps placed for the purpose. The head is fixed by the rings, the two fore-legs by the rings, and the left hind-leg by the rings. The right hind-leg is fixed, raised at the further end of a curved bracket; the whole inguinal region on this side is thus exposed, well stretched to our manipulations. The marks represent excavations prepared for zinc vessels, ready to receive fæcal matters, and urine.

To free the animal, we tilt the table again, this time to make it vertical, after having loosened all the fetters, with the exception of the large central strap, which we only unfasten when the creature is upon its legs.

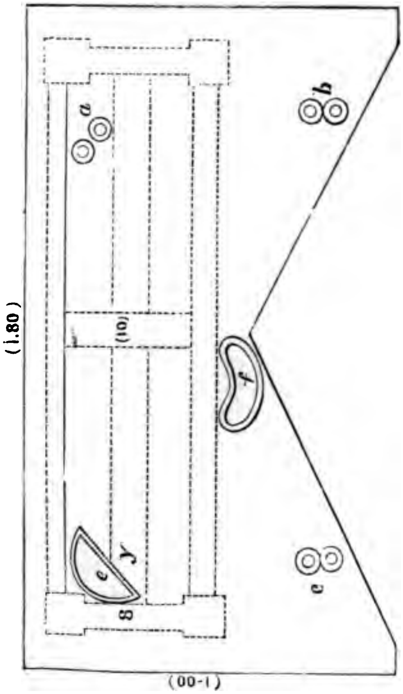
The operation of shaving is long and difficult. It is necessary, first of all, to cut the hair with scissors, then to lather the part with soap and hot water, and, last of all, to use the razor, a task which the agitation and movements of the subject renders very irksome. Perhaps some day, we may find some depilatory preparation capable of taking the place of the razor. This would be very desirable.

The surface to be denuded, should be about as large as the crown of a man's hat, and reach from the inguino-mammary region towards the umbilicus. It is on this surface, that the incisions or punctures destined to receive the vaccine, will be made. The incisions, numbering from 80 to 100, or even 150, should scarcely go deeper than the epidermis; they are about a centimètre long, and are made in the direction of the axis of the animal, in order that, later on, when we come to make use of the vesicle, the spring forceps applied to them, shall not be forced off by the movements, which lassitude or illness induce the vaccinifer to make, and which cause elongation of the longitudinal, at the expense of the bilateral axis. The incisions are about two centimètres apart. When the operation is completed, the animal being stretched on one of its sides, they appear as a series of ladders placed side by side, about two centimètres apart, a distance which similarly separates their steps. To allow every facility for the expansion of the vesicle, it is useful to arrange the steps of neighboring series, a little crosswise.

As the line of incisions is made, we introduce the vaccine matter, whether it be preserved (which is always



See Lu. 8



See Description, page 111.

a last shift), or by preference, taken from an animal which has been vaccinated five or six days, and which, to serve this purpose, has been fixed on a neighboring table.

Punctures are made with a grooved lancet which is charged with vaccine, and introduced obliquely under the epidermis. We may place these more closely together than we can the incisions, because the vesicles which result from them, are always smaller than those which come from the latter.

7. Adult animals must be treated in a similar manner, which demands that we should use a very strong apparatus.

The tilting-table is composed of two parts* (*see* plate p. 119): First, the under part composed of four pedestals of elm, 10 centimètres thick and 50 high, joined above and below by cross-pieces, 10 centimètres broad by 4 c.m. thick. (The upper frame is 16 c.m. high.) Second, the upper portion of the table (the tilting part). This is 2 mètres and 40 centimètres long, 1 mètre and 40 centimètres wide, and 4 c.m. thick; it is made of pitch-pine. The various planks are joined together by five cross-pieces of elm, with the aid of wooden screws. The cross-pieces are 5 centimètres thick.

Along the line AB, are five very strong hinges. Ropes are needed, and are placed as follows:

1. A rope 6 mètres long and 1 centimètre in diameter, is fixed by a rivet to ring 8. This must be applied to the whole of the right side of the cow; it serves to

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* Military Vaccine Institute at Antwerp. Report of the Chief Physician, M. Riemslagh.—Note on the operation known as "placing the cow on the table," by M. Deghilage (*Archives médicales Belges*, Février, 1882, p. 114).

keep it against the table and to prevent it from moving forward.

2. A cord 4 mètres long, fixed to ring 6, will be attached to ring 8 (this ropes serves to fix the head). After having made two figures of 8 in such a way that the resistance shall be midway between the horns, we pass the rope over the head to fix it ultimately to ring 8.

3. A rope 9 mètres long and 2 centimètres in diameter, which shall be held by pulleys 10 and 11, in such a way as to leave two free ends, each about 4 mètres long, which must be brought back afterwards to pulleys 2 and 3. These two ropes serve to lift the belly of the cow, and to hold it against the table during the operation.

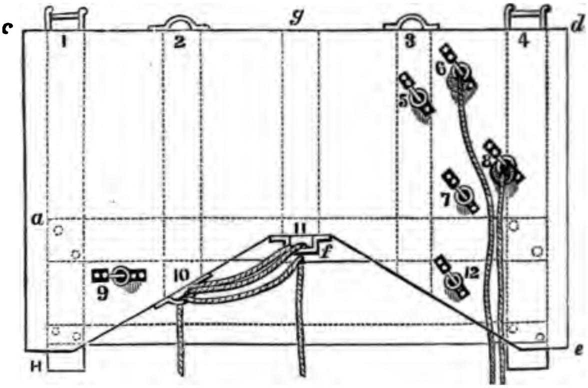
4. A leather strap passing through rings 5 and 7, to act as a collar, keeps up the neck.

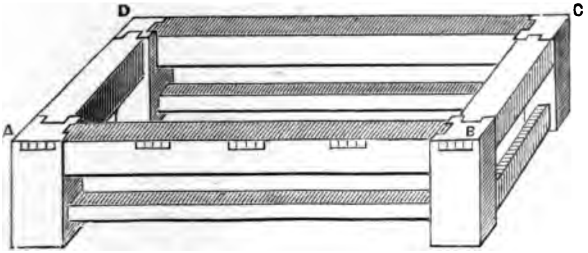
Fetters are also used. Their object is to keep the four legs under the belly of the beast, which loses its equilibrium, and, in consequence, all power, for it has no point of support. The fetters are similar to those used in veterinary medicine in slaughtering animals. They are composed of four manacles, jointed at their centre to an iron ring. They are applied to the four legs immediately above the hoof. A rope attached to one ring passes through all four, in such a way as to form an ovoid, which becomes smaller and smaller in proportion as we draw upon it. A long board is also needed, to place the right hind-leg in the special position, described later on.

The Operation.—The upper part of the table, with its ropes arranged, is placed vertically.

A bundle of straw is spread out over the table, with *the* object of hindering the cow from slipping.

TABLE FOR VACCINATION OF ADULT ANIMALS.





See Description, page 117.

Five assistants are necessary; we will designate them by the numbers 1, 2, 3, 4, and 5. The cow is led against the table, its head opposite rings 5, 6, 7, 8.

Assistant 1, by means of the rope attached to ring 8, holds the cow firmly against the table and prevents it going forward.

Assistant 2 fixes the horns and head to rings 6 and 8. Assistants 3 and 4 place the cords 10 and 11 into the pulleys 2 and 3, and fix the animal against the table. Cord 8, now become less useful, may be let go, and we then pass it twice round cords 11 and 3 and 10 and 2; we next place it, once more as at first, but low enough to support the fore and hind quarters, during the rocking movement.

This is the time to fasten on the fetters. We begin with either of the two fore-legs. Those two fetters are easily placed. It is more dangerous and more difficult to place the hind fetters. To avoid kicks, it is prudent to stand beside the belly of the beast. We may also for this purpose raise with a strong lever, one of the fore legs. We will begin with—it doesn't matter which hind leg—but we must take care to place that fetter to which the rope is tied, on the left hind leg, for the right hind leg must presently be freed to be placed in a special position. We then pass the rope through the four rings of the fetters. We adjust the strap to the neck (ring 5—7).

We may now proceed with the tilting movement. The five assistants are then placed as follows:—

1, holds rope 10—2 and fetter 1;

2, holds rope 11—3 and fetter 4;

3, holds the cross rope 8 and vigorously draws the beast against the table;

4, the strongest assistant, holds the tail and pulls upwards with all his strength, for the hind quarter, which is the heaviest and the least supported, tends to slide downwards.

5, the assistant who draws the cord through the fetters, controls the tilting movement at the moment when, drawing on the cord through the fetters, he sees that the cow is about to lose its equilibrium. The latter now offers no resistance. This manœuvre, when it is well executed, is easy, free from danger and very expeditious.

We can place a cow on the table in less than five minutes. Cords 10—2 and 11—3 are respectively attached to manacles 1 and 4.

Cord 8 is tied across the table. The fetter-rope passes into the ring 12, and is also tied across the table.

To lay bare the mammary region, we seize the right hind leg in a notch in the long-board, at the spot where the fetter is placed. The rope passes under the left shoulder, then returns to the foot, immediately over the notch in the long-board. We draw the cord, after having freed the right leg from its fetter, and we fix it firmly to pulley 3. The object of this manœuvre is to bend the limb as much as possible, so as perfectly to lay bare the mammary parts. The hoof should be at the level of the shoulder-joint.

The manœuvre for letting the cow down is much shorter and more easy.

We free the limbs from their fetters, beginning with the right hind limb. We detach the head, neck and all other ropes successively. The cow, thus disengaged, remains perfectly quiet. When we tilt the table the five assistants are placed as follows:—

No. 1 at the head to support it, and afterwards to prevent the cow running off; two assistants at pulleys 2 and 3 to raise the table, and support the cow, by means of ropes 10—2 and 11—3, which rest in pulleys 2 and 3, until the beast is upon its feet.

The two others are placed at cross rope 8, and at the tail; they pull vigorously upwards, and away from the table, to keep up the hind quarter, which tends to descend too quickly.

One does well, before letting the cow down, to gently rub its limbs, benumbed by the uncomfortable position in which they have been kept.

CHAPTER III.

DEVELOPMENT OF THE VACCINE ERUPTION IN THE BOVINE SPECIES.

8. At the end of about forty-eight hours, if the inoculation is to be successful, each incision is surrounded by a light-red border, which, twenty-four hours afterwards, rests upon a swelling whose size increases rapidly, to come out, at the end of the fourth or fifth day—depending on climate and season—in vaccine vesicles.

The vesicles are shaped like an elongated coffee-berry, with a longitudinal cicatricial depression, corresponding in extent to the incision of insertion, surrounded by a zone of transparent silvery-white, itself encircled by another red zone. According to the extent of pigmentation of the skin at the point of insertion, these vesicles present, at their centre, a tint sometimes bluish, sometimes yellow or orange, sometimes red or violet-coloured.

The little swelling keeps growing during the seventh and eighth days; the transparent zone becomes white, chalky, then yellow; on the subsequent days, the vesicles becomes purulent, then dries up and is changed into a dark scab, which only falls from the fifteenth to the twentieth day.

When we have operated by puncture, we obtain rounded vesicles, following, during their development, the course which we have just described, always with this difference—which may be explained by the fact, in this instance, the resistance offered by the epidermis has to be overcome, while in the other, we have operated with an uncovered surface—that the eruption is about twenty-four hours later. This circumstance may be made use of to obtain, on the same animal, vesicles in two stages of development, which cannot but be of advantage.

For ordinary purposes, we use incisions in preference to punctures; they are earlier, more productive, and admit of being more easily enclosed and isolated, by the curved clasp of the expressing-forceps.

The vaccine is only fit to be used, as it is, during twenty-four hours; to use it advantageously, either for vaccination or for preserving, it is necessary to choose the opportune moment. But this moment, which experience alone teaches us to recognize promptly, and is that during which the pale areola has its transparent appearance and silvery colour, varies according to the temperature: in summer, it most frequently arrives during the course of the fifth day, in winter during that of the sixth.

There may be a margin of twenty-four hours during which the matter remains transparent, but we must not reckon upon it; the most favourable moment approaches most nearly to that, when the silvery tint has just *commenced* to show itself, under the guise of a little white border, parallel to the incision or rather to the cicatrix which replaces it.

In the vesicles of human vaccine, the fluid matter is distributed in such a way, throughout the parenchyma of the little swelling, that it transudes in the form of clear droplets as soon as we have slightly pierced, with a lancet or even with a needle, its outside envelope. In those of animal vaccine, it is not so; one may cut the external cuticle considerably, without seeing the least particle of lymph ooze up. It is necessary here, then, for gathering it, that we should force out the lymph by compression of the swelling. We have had made for this purpose a curved forceps, exercising a pressure which is maintained by means of a grooved catch. This forceps should be placed in such a fashion that its convexity presses, not the tissues situate beyond the swelling, but the base of the latter alone; the upright parts of the forceps limiting the tumour itself on each side, prevents the fluids of adjoining tissues from running in at the sides (*see* plate p. 127).

The vaccine fluid is made up of two chief constituents; a vehicle, which is nothing but serum, and solid bodies, amongst which are the special granulations which represent the virulent power. This fact, placed beyond doubt by M. Chauveau for human vaccine (38), has been rendered equally beyond all dispute for animal vaccine, by the experiments which MM. Carsten and Coërt* performed at La Hague, with the aid of M. H. W. Pareau, and of which, we here give a *resume:*

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* "Animal Vaccination in the Low Countries; Some Provisional Experiments performed at the Vaccine-farm at La Hague, on the Special Qualities of Vaccine-virus." By Carsten and Cœrt. (Congrès Médical d'Amesterdam, 1879)

These authors report that "animal vaccine was filtered through some Berzelius paper, and through little plates of porous porcelain, by the aid of a pneumatic machine. Microscopical examination teaches us that this paper retains epithelial cells, fibrinous coagula and other solid particles, but that it allows those *globular molecules*, which are found in large quantity in vaccine lymph, and which we take for micrococci, to pass through. The porcelain plate transmits, neither these molecules, nor any other morphological particle.

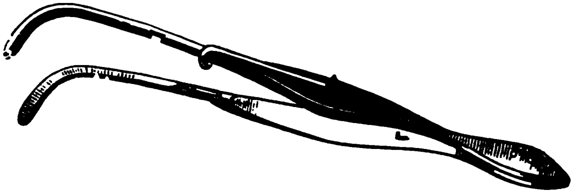
"We have repeated these filtrations in several ways, and we have been able to determine, each time, that inoculations performed on calves, with the aid of the serum, deprived by filtration of its globular molecules, gave only negative results. When, on the contrary, these molecules had been kept in their vehicle, the inoculations were constantly successful.

"We have mixed, and washed the vaccine with much water, to separate these molecules from other solid particles which might adhere to them, and which we might have considered equally endowed with some virulent property; then we have caused to pass through the porcelain plate, all that the latter allowed to pass through it. Inoculation with the matter left on the filter has still been followed by a positive result.

"It is evident that here, as in human vaccine, the virulence is inherent to the globular molecules."

The identity, then, is complete, as to the nature of the active principle of vaccine, whether it comes from the cow, or from the child. It is, in both cases, a typical granulation suspended in serum. The serum only differs

EXPRESSION FORCEPS.



See Description, page 125.

a little: it is more plastic in the cow, perhaps because the vaccine obtained from it, has had to be *expressed* by force, which may have driven forth more fibrin-forming bodies; hence, a greater tendency to coagulation, which renders more difficult, the preservation of animal vaccine in the liquid state, or rather its expulsion from the capillary tubes, into which it has been introduced.

CHAPTER IV.

COLLECTION AND PRESERVATION OF ANIMAL VACCINE.

To procure a supply of human vaccine, there is but one method: to open the external covering of the little vaccine swellings, on the seventh day of their development, and wait.

We then, observe a portion of the contained serum ooze up, containing a more or less considerable quantity of the specific virulent granulations, which it has taken up in its passage, and in washing against the trabeculæ.

For the collection of animal vaccine, our intervention is less passive; the vesicles may be compressed, scraped, excised, in order to make them give up the whole of those concealed constituents, which are needed for the propagation of the vaccine; hence, the various modes of preparing animal vaccine, absolutely unknown where human vaccine is concerned, and fertile in new resources, which we are about to describe.

9. I. *Liquid Animal Vaccine*—A. *Tubes.*—The vesicle is seized between the prongs of the expression-forceps, which at once forces out a little serum, mingled with blood and external detritus, such as the vaccinal scab, necrossed epithelium, impurities arising from the litter, etc. The whole of this first spurt is rapidly wiped off by a touch with a handkerchief. Then, the vaccine lymph wells up gently, in the form of a transparent viscous fluid. If, at this moment, we place in the little pool thus formed, the end of a tube open at both ends, the liquid runs in, and soon fills it.

This method is elementary; unfortunately, tubes thus filled, soon become useless; in a few hours, a fibrinous clot forms, which it is difficult, and often impossible, to move. Something has happened to change the quality of the contents. This vaccine deserves no confidence.

We must obtain it in some other way. We place in a glass or porcelain capsule, or some other receptacle, the fluid contents of a certain number of vesicles, which we have forced out by means of the expression-forceps, and we stir in some drops of distilled water, added to an equal quantity of glycerine; we mix, we remove the detritus, residuum, coagulum, blood globules, fragments of epithelium, etc.; then we cause to pass into the tubes, the liquid which, thus cleansed and freed from its chief coagulants, rushes into them, and keeps well.

It matters little, whether we make use of cylindrical tubes, or of tubes with a central enlargement.

Vaccine prepared in this way preserves its limpidity, and is safe from any putrid change. Observation, however, has taught me that though virulence may often be maintained for a long time, this longevity is far from being the rule. In the great majority of cases, it diminishes rapidly, to cease altogether in about five or six days. We must no longer lose sight of the fact, that this vaccine is diluted, by the addition of a certain quantity of watered glycerine, and that it must be used freely by means of scarifications, if we wish to range on its side, the greatest possible chances of success. We may indeed avoid this inconvenience by neglecting such addition, but we then cease to be guarded against the decomposition, which always happens after a little time, even in tubes to all appearance hermetically sealed.

B. *Glass Plates.*—Some people, ignorant of what actually happens in vaccine lymph, enclosed between such plates, on account of having occasionally found it damp after the lapse of several days, considered them a means of preserving vaccine in a fluid state. This is a serious mistake, concerning which we have already explained ourselves. Glass plates, as a means of preserving vaccine in the liquid state, belong to the past, and ought to be relegated to it, to give way to other, more certain and more practical methods.

10. II. *Dry Animal Vaccine.*—A. *Ivory Points.*—These are plates, square at one end, pointed at the other, 5 centimètres long, 6 millimètres broad, and as as thick a playing-card. To charge them, we seize the vesicle with the pincers, whose arms we press closely together, then we wait a few moments; then we place the plate, first on one side, then on the other, into the matter which comes to the surface of the vesicle, in such manner that it may be coated with vaccine on both sides for the length of 1 to 2 centimètres, starting from its pointed extremity. Afterwards, we place it upon the edge of an overturned dish, the lower end resting upon the raised circular border which we find there, the point directed wards the centre of the dish; when it is thus sloped, it towards this point, that the matter with which it has t been coated, runs; we thus place thirty or forty in

order, one beside the other, on the base of the same dish, and then expose the latter, either to bright sunlight, or to the radiation of a fire, giving a heat of similar intensity. In a quarter of an hour, the vaccine is dried by the evaporation of its fluid constituent, and the "point" may be used.

If the ivory be not very hard and well polished, it becomes penetrated by the vaccine; in this case, it is wise to coat it previously with a layer of mucilage of gum-arabic, which we allow to dry thoroughly, before applying the vaccine to it. If a first layer of vaccine does not seem sufficient, we may, after the drying is complete, lay on another. Then, if we desire to preserve the points from the action of the air, with the object of prolonged preservation, we clothe the portion supplied with the vaccine with another layer of gum-arabic, and we cover the whole with tin-foil.

Points thus prepared, as a rule, retain their activity for a long time; which is explained by the liquid part, in its evaporation, having freed the solid portions or vaccine granulations, from elements favorable to putrefaction.

To make use of the points, we must open to the vaccine, a wider door than punctures can offer, and for that we must act as follows:—

Place on one, then on the other surface of the ivory point, a drop of lukewarm water, which is left there until the vaccine is thoroughly softened. Make, then, at a distance of 1 millimètre from each other, two or three scarifications, about 4 millimètres long, involving only the epidermis, or *better*, a single circular incision with the aid of the trephine-vaccinator. When blood flows, allow it to cease, then rub the vaccine-charged point over the well-stanched wound. If blood now mixes with it, collect the whole over the incisions and allow to dry.

Vaccination by scarifications, still meets with a few opponents. They charge it with being painful and difficult, with causing much bleeding and large vesicles; with being a source of fright for subjects, and for witnesses.

It is to satisfy these, that Dr. Umé contrived his *vaccine-scarificator* (*see* Plate p. 135). This instrument consists of four blades fixed upon a horizontal axis, to which may be given an alternating rotatory movement, by means of a toothed wheel attached to the stem, and controlled by a rack. The movement of the latter from above downwards, is given by the operator, by means of slight pressure exerted on a knob which finishes off the upper part of the instrument.

Movement from below upwards, is determined by the reaction of a spiral spring, compressed by the descent of the stem. Fixation between the two movements is assured, by a catch fitting into a notch, placed near the upper end of the rack-stem, and maintained in this position by a spring-blade; it is upon this that we press, by means of a lever adapted to the catch, in order to free the latter from the notch, and thus allow the spiral spring to act.

The depth, to which the blades penetrate, is at the choice of the operator, thanks to a plate in which openings are cut for the passage of the blades, and which may be brought nearer to, or removed further away from, the axis of rotation of the latter, by aid of a ring adjusted side; this moves on a screw, placed for that purpose the external surface of the box, which encloses the s of rotation, as well as the blades.

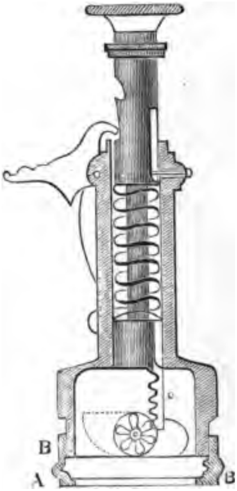
Practice with this instrument is very simple. To make use of it, the operator presses the knob which forms the upper end of the rack-stem, until the catch is fixed in the notch; the apparatus thus arranged is placed on the arm.

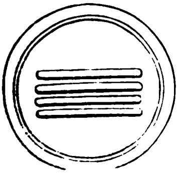
Slight pressure made on the catch, frees it from the notch, and the stem, thanks to the spiral spring, rises quickly, dragging with it the blades, which, describing the arc of a circle, produce the scarifications.

We have borrowed **M.** Umé's notion in constructing a lighter apparatus which we have called the vaccinator-trephine (*see* plate p. 137). This consists of a circular blade, 2 millimètres in diameter, enclosed in a circular sheath. A rotatory movement is given to it by the play of an internal spiral. The instrument being accurately applied to the well-stretched skin, it is only necessary to press the end of the forefinger vigorously on the knob, to set going the blade, which traces a circular furrow of a depth measured by the projection given to the blade, a projection increased, or diminished, by turning backwards, or forwards, the protecting ferrule. In the case of little children, with fine skins, the blade should scarcely be passed below the rim of the sheath. The incision made, the vaccine is applied in the ordinary way.

It has been said, that animal vaccine must be less active than human vaccine, since it has been necessary to invent a new method of introducing it. This is a mistake. Vaccination by scarification is not a new procedure; for many years, it has been used in England, and in Belgium. Besides, it was not designed for animal vaccine alone: every vaccination *with preserved vaccine* should be made freely on a large surface, if we wish to assure success.

B. *Vaccine Powder.*—In Italy, Dr. Frappoli has

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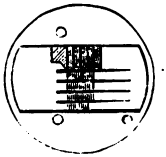
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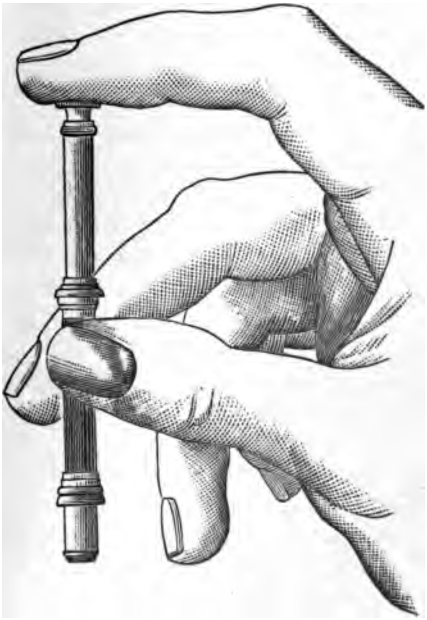

See Description, page 134.

attempted to preserve the vaccine vesicle in a dry state, and M. Ciaudo* states, that he has obtained very good results with vesicles, dried from 110 to 130 days. Dr. Verardini has undertaken this operation, with the aid of the bell-glass of a pneumatic machine, under a pressure of from 10 to 15 mm. of mercury, as is done with substances destined for elementary organic analyses. He is able, thus, to dry at once, at least, 300 vesicles, and the operation lasts only five or six days. It has been proved, that the vesicles are better preserved in proportion as the temperature is lower; this is kept, by means of ice at 6° above zero. Then we have heard† that M. Pessin has been able to prepare a vaccinal powder, by reducing to dust, fragments of vesicles impregnated with glycerine, and dehydrated in one of the machines for desiccation, which are met with in chemical laboratories.

Convinced that substances mixed with glycerine could not be dried—that there must be some mistake in the report which we have read of the *modus faciendi* of M. Pessin, of which we have just spoken—we gave our attention to vesicles cut up into small fragments, which we had submitted to rapid dehydration in an apparatus *ad hoc*. At the end of two or three days, these fragments could be reduced—as Dr. Margotta, of Naples, had already found—to a fine powder, which we preserved *in the dry*, in tubes closed only by a cotton-wool pad, so as to allow the vaccine microbes to enjoy a certain amount of air and moisture, favourable to the preservation of their latent energy.

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* Ciaudo, "Concerning Calf-lymph. A Comparative Study of Animal and Human Vaccine." A memoir rewarded by the Academy of Medicine in Paris in 1879. Pp. 120, with illustrations. Paris: Ad. Delahaye. 1882. Pp. 21.

† *Gazette Médicale de Paris*, 1882, No. 33.

This powder ought to preserve its activity for a long time. Without being yet able, for want of sufficient experience, to pronounce either on this point, or, as to the best mode of using the powder thus preserved, we will state what we know on this last matter at the time of writing these lines: introduced as it is and dry, into the incisions which we make in calves for vaccination by ordinary methods, the powder has seemed to us to develop with difficulty, and success has not been the rule. When, on the contrary, we have given to the microbe, the means of passing from a latent state to one of active life, by allowing the powder to macerate in glycerine water for twenty-four hours, we see the particles regain their size, fill out more and more, in the same way as foods, dehydrated with a view to preservation, fill out when thrown into water. The preparation, thus obtained, has given us the best results, although we made use of powder, already more than three months old.

III. *Animal Vaccine in Pulp.*—A. *The Vesicle Alone.*—In the early days of animal vaccinations, this was the procedure particularly recommended; the vesicle was cut out, seized with pincers for the purpose, the lower surface being turned up, and scratched with a lancet, in such a way as to bring out the lymph, which was inserted, either by puncture, or by being deposited on scarifications made in the skin. There was nothing to say against this method, so far as the results were concerned;—like an execution, it was merely the brutality of the practice: the wound, made in the abdomen of the vaccinifer, from which the blood flowed in waves, and the shred of *skin,* scarcely attractive to look at, placed under the eyes of the vaccinated—but only against the well-understood condition of having to use it on the spot. So soon as the vesicle was placed on one side for purposes, more or less remote, crowds of inconveniences presented themselves: the vesicle shrank rapidly, and, a much more serious matter, began to decompose, within a period whose duration could never be decided, which might thus be the starting-point of the most serious accidents. Let us recall one instance: In 1879, the doctors at San Quirino d'Orcia, inoculated thirty-eight infants, all less than twenty months old, with vaccine derived from vesicles which had been sent them from Rome, and which were not used, until five or six days after they had been excised. It was summer time, and the vaccinators never allowed themselves to be warned by the musty smell, which came from the vesicles. Whilst waiting for the result of the vaccination, these unfortunates found that they had inoculated septicæmia, which betrayed itself in most of the vaccinated by large inflamed swellings, undermining the muscles, penetrating into the joints, and accompanied by convulsions, etc. The disaster was frightful.

This method is nowadays completely abandoned; or at least, those who still use it take care to exercise certain precautions, of which the chief is to place the vesicle in glycerine, immediately after having cut it out, and to keep it there until the moment of using. To hasten the process, we place this in a hollow, scooped out in the middle of a thick plate of glass, which we cover over with another plate, also of glass. These two plates are kept together by paraffin, or some other adhesive agent.

B. *Glycerinized Pulp.*—This method, which consists of using the whole vesicle, freed from irritant substances with which it may be smeared or infiltrated, is evidently the most logical, since it yields to the vaccinator, all the virulent contents which the vesicle may enclose. It is also, that which nowadays, in practice, numbers most partisans. Perhaps we may be astonished at the long time that it has taken for its introduction; the imperfection of the methods made use of, must alone be blamed.

The Animal Vaccination Committee of the town of Milan seem first to have introduced this mode. This is how this preparation is made:—They excise the skin with the vesicles, they fix the shred upon a small board with a strong pin, and scrape the vesiculated surface so as to get rid of all detritus. "We make of it," says M. Ciaudo (*loc. cit.*), "a homogeneous paste, adding half a gramme of chemically pure glycerine, for each vesicle employed. We place the vaccine, thus prepared, in a little glass bottle, which we half fill with glycerine, which serves as a stopper and preserves it from contract with air. We keep the phial in a cool place, and when we wish to take out the vaccine, we have only to take up the glycerine, and drop the paste on to the open end of a goose-quill, cut obliquely, which, for expedition, we enclose in another quill, a little bit stronger."

This preparation is very active and keeps for a long time; those who introduced it into practice, have made indisputable progress. It requires, however, to be perfected, with the object of removing from it, the irritant element, which, in the vaccination of children, too often manifests its effects in inflamed vesicles.

In Holland, a method founded on the same principles, is employed. The pincers being applied, they scrape vesicle with a bistoury, and place between two glass plates, the detritus thus raised, after having added some glycerine to it.

Similarly, it is upon these principles, that is based our own process; only we first, by a species of decortication, cleanse the vaccine vesicle with the greatest care, from every possible impurity with which it may be contaminated, and, particularly, from the so-called vaccine scab, which, though it may contain a considerable proportion of virulent principles, which we may regret being obliged to sacrifice, is in great part made up of foreign bodies. That done, what remains—that is to say, the core of the vesicle itself, freed from all impurity—is reduced, by a special method, to a thin mass; it is then treated with glycerinized water, and we introduce the emulsion thus obtained, into cylindrical tubes of amber-coloured glass, which we seal in the cold. Should it be desired to make a pomade of it, we incorporate it with an appropriate aseptic excipient, as we now do. The vaccine pomade is preserved in small bottles of amber crystal, stoppered with emery. It keeps in these so well, and so long, that we no longer hesitate to advise vaccinators, especially during epidemics, to provide themselves with similar phials—indeed, to carry them habitually in their cases, for use at times of need. One or more vaccinations performed, we replace the stopper, and so keep the phial ready for new eventualities. This emulsion and pomade have not been found to fail, during the month after their preparation, and we have been able to send them intact, to the most distant destinations.

12. *Appreciation.*—For the fourteen years, during which I have directed the State Vaccine Institution in Belgium, we have endeavoured to improve the modes of culture, and preservation of animal vaccine. Nothing

had been done to this end, when we began this work. We approximated the tube to the open vesicle, and it gave what it was able. A little later came the expression-forceps; the vesicle after that, gave forth all we asked of it—sometimes even more—but the fluid obtained soon coagulated in the tubes, and no good was done. Later still, thanks to a little glycerinized water, we dropped on something better. The matter no longer putrefied nor coagulated, but it was *diluted*, and experience soon showed that this preparation hardly retained its activity, longer than five or six days. However that might be, a first advance had been accomplished. For the interior of the country, where the postal service is rapid, the vaccine arrived early enough when used as soon as it arrived, as the instructions accompanying each parcel expressly recommended.

This result, although it did not come up to the ideal, was nevertheless considerable. The change furnished by animal vaccine, even under these conditions, sufficed from the beginning to fulfil its *rôle* of reserve, the only one to which it aspired.

It was not less necessary to continue the search. We then thought of using for calf lymph, the ivory points which had long been used in England for the preservation of human vaccine. This was altogether a revolution. The employment of dry vaccine involved a reform in the *modus faciendi;* the traditional puncture had to give place, not quite without a struggle, to multiple free scarifications. Nevertheless, the reform worked; ivory points made their way, not without some objection. It is to them, in fact, that we owe the possibility of stating* that the vaccinations, and re-vaccinations, performed in 1870 and 1871 by thirty-six Belgian doctors, with vaccine on ivory points delivered by the State Vaccine Institution, gave: 1st—in 500 cases of vaccination, 479 successes, or 96 per cent.; and—in 5,425 re-vaccinations, 3,419 successes, or 62 per cent.

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* *Bulletin de l'Académie Royale de Médecine de Belgique,* 1871, t. v. No. 7.

This proportion, nevertheless, whether due to special medical care or to a privileged series, did not keep up. We have recently seen in what fashion, and to what extent, it is nowadays surpassed.

The vaccine *emulsion* and *pomade* enjoy an activity nearly approaching that of *living* vaccine, and keep to that extent, during the whole of the first month. During the whole of the second month, this activity is slightly enfeebled; it is far from being entirely extinguished in the third.

We do not think it possible to go much beyond that.

APPENDIX.

RESULTS OF RE-VACCINATION—ANIMAL VIRUS.

The first volume of ***Arbeiten aus dem Kaiserlichen Gesundheitsamte***, in Berlin, contains the results of vaccination in the German Empire in 1882. The population of that year comprised 1,459,377 children, or 3.70 per cent. of the total population, of an age to be primarily vaccinated, but of these 681 had previously had small-pox and 120,232 had already been successfully vaccinated, leaving 1,338,464 children requiring the operation. Of these 1,158,696 were successfully vaccinated, or 95.98 per cent; 31,441 without result, or 2.35 per cent.; and in 5,773, the results were unknown. Thus, of the total number, 142,507 remained unvaccinated. The reason of the increase of unsuccessful vaccinations in the Grand Duchy of Hesse, was owing to the introduction of animal lymph, where the number of successful vaccinations decreased from 97.31 per cent. in 1881 to 63.44 per cent. in 1882. Thus, if the results in Hesse be omitted, the children in the other States who were successfully vaccinated amounted to 97.48 per cent. of the total vaccinations.

It is instructive to find this statement in an official report of the German Empire following, in but a few weeks, the publication of conclusions of the "German Commission on Vaccination," which are as follows:

For vaccination with humanized lymph, may be mentioned the certainty of its action, the simplicity of its machinery, the inexpensive manipulation of the lymph.

Against it, are urged the known dangers of vaccino-syphilis and erysipelas, the possibility of the conveyance of tuberculosis, and the difficulties which arise in the manipulation of the lymph.

For the use of animal lymph, there are urged the security against vaccino-syphilis, the advantages of a quantity of lymph produced at the same time, the possibility of manipulating lymph antiseptically, and thus a greater safeguard against erysipelas.

Against it, may be taken the less certainty in its results, a more complicated machinery and the greater cost of production of lymph.

On the whole, however, it must be acknowledged that the advantages of animal lymph outweigh the disadvantages connected with its use, and that it is capable of supplying the place of humanized lymph.

In conclusion, the chief reasons for this decision may be stated as follows:

Compulsory vaccination can only be maintained, if injuries to health and life through vaccination, and especially vaccino-syphilis, can be prevented.

This condition cannot be fulfilled by vaccinating with humanized lymph.

Vaccination with animal lymph, which in recent times has more nearly approached the use of humanized lymph in its certainty of result, excludes all possibility of syphilis, and offers greater security against other diseases, such as erysipelas. On these grounds, vaccination with animal lymph should in future take the place of vaccination with humanized lymph.—COMMISSION ZUR ERORTERUNGDER IMPFFRAGE. (*Denkschrift über die Northwendigkeit der Allgemeinen Einführung der Impfung mit Thier-lymphe.*)

The report just issued of the Medical Officer of the Local Government Board (*Fourteenth Annual Report of the Local Government Board,* 1884–85*; Supplement containing the Report of the Medical Officer for* 1884) gives important evidence on these points:

1. As to risk from use of humanized lymph, Dr. Buchanan says: "I wish you again to note the extent of the danger that accompanies vaccination under the circumstances of English vaccination practice. There is little that man, woman or child has to do, or to have done for them, that does not contain an element of danger, but reasonable people, while endeavoring to remove all preventable risk, do not regard this risk as a reason for not doing what is proper to be done. For example, I find, from the last published annual report of the Registrar-General, that 974 children under one year old were suffocated in a twelvemonth by bed-clothes. The fact gives a reason for care in the use of bed-clothes, but gives no reason for going without them. So, 55 deaths (51 being of infants under one year) were recorded in that report as from vaccination and the results of vaccination. They doubtless were, for the most part, cases of erysipelas, and their occurrence gives reason for cleanliness of lancets, for avoidance of filthy vaccination shields, and generally for care in vaccination; but it assuredly gives no reason for going without vaccination. When we learn from the same report that five infants died in the same year from circumcision, the dimensions of the danger implied in the 55 deaths by

vaccination may be understood. As for any remoter injury to the health of the community attributable to vaccination as practiced in England, I can find no evidence of it, statistical or other.

"As a matter of English practice, with all the opportunities for knowledge that come to me, and with an eagerness of search after fact, I cannot learn of communication of syphilis in vaccination being actually effected once in a million of vaccinations.

"I do not think it necessary to speak at length of tubercular diseases of children. The small increase of deaths registered as 'tabes mesenterica' has been balanced by a decrease in the deaths of children under five registered as from 'phthisis,' the death rate from the two together having kept very closely uniform, and the changes in registered mortality of the one and the other, being obviously a question of which of certain synonyms is used in medical certificates."

2. As to relative success with animal and humanized lymph.

"In England, these are identical when the operation is done directly from arm to arm. Thus, two operations at the Animal Vaccine Establishment, in London, produced an average of 988 vesicles for every thousand insertions of calf lymph made on infants. Now, the employment of stored lymph reduces this average by some twenty or thirty per cent., whether humanized or animal lymph be used. Direct vaccination from calf to arm is only possible in large centres of population. In sparsely inhabited districts, the use of stored lymph becomes a practical necessity, unless arm to arm vaccination be resorted to. Hence, there is much probability that the decision of the German Commission will tend to reduce the condition of the German people as to protection against small-pox, to the condition of the inhabitants of the Grand Duchy of Hesse."

The Kingdom of Saxony has made arrangements for the immediate replacement of her present system, by the institution of four animal-vaccine stations, the lymph from which will be supplied gratis to public vaccinators, and at a cost of fifty pfennige for each tube to private practitioners.

How far the compulsory re-vaccination law of 1874 in Germany—which requires the re-vaccination of children at twelve years of age, and which it is proposed now to apply to children of ten years of age—may reduce the injury which has already been experienced in Hesse, time alone can show. The beneficial effect of this law is well indicated by a comparison of the death rates from small-pox since 1874 in Berlin, Hamburg, Breslau, Munich and Dresden, with those in London, Paris, Vienna and St. Petersburg. The extraordinary comparative disappearance of the disease from the German Cities contrasts in a marked degree with the prevalence of the disease in the other cities mentioned. Or, again, the relative conduct of the disease in Prussia, where its comparative absence is emphasized by the prevalence of small-pox in Austria, where this law does not exist, is not more remarkable than the difference of liability to small-pox of the armies of the two countries."—*From the American Journal of the Medical Sciences, January*, 1886.

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CONCERNING ANIMAL VACCINATION.

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Fluid Extract of Ergot.

In presenting to the Medical Profession our Fluid Extract of Ergot, we fully realize the responsibility assumed, in making the representations we do in regard to our preparation.

No article in the Materia Medica has so often disappointed the practitioner, and scarcely any drug is more susceptible of change, deterioration. and in time, to become entirely inert. We have hesitated to ask the unconditional endorsement of the Profession, until we had fully demonstrated for ourselves, the value of the Fluid Extract we make, but, after nearly ten years continued evidence of its successful use in the hands of medical men throughout the country, during which time, we have manufactured many thousands of pounds, we confidently claim for it, a value and efficacy superior to any other preparation of this drug.

The menstruum used, is that best adapted for extracting all the active matter, and retaining its full power. Each minim represents one grain of the freshly powdered drug. It is entirely free from acid, and can be used subcutaneously, without irritation in most cases, having in this respect, a great advantage over the watery solutions, which decompose very rapidly. Our menstruum is simply Water, Alcohol and Glycerine, no heat whatever being used in its manufacture. Since adopting this formula, a number of valuable papers from foreign authorities have endorsed our views. Our large operations and long experience enable us to select the choicest importations of Ergot as offered, thus insuring material of unexceptionable quality. It will always give us pleasure, to send samples to any member of the Profession who may desire to test its value, or confirm our representations, by experiment in private practice, or in institutions with which he may be connected.

Our list of Fluid Extracts embraces all those generally manufactured. We claim for them, careful selection of Crude Material, intelligent and accurate manipulation, and conscientious exactness in every detail. Complete lists will be furnished upon application.

JOHN WYETH & BROTHER,

CHEMISTS, PHILADELPHIA.

SPENCER'S CHLORAMINE PASTILLES.

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right to manufacture, our appliances and experience enabling us to prepare these Pastilles, so as to prove more permanent, than when manufactured by former proprietors.

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CHEMISTS, PHILADELPHIA.

Compressed Lozenges

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